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ID-00173

Naval Station Newport

ELDN 10407

Environmental Protection Department

Design Analysis
for
90% Design Final Submission

Interim Remedial Action

Tanks 53 and 56 - Tank Farm 5
Naval Education and Training Center
Newport, Rhode Island

Submitted to:
Northern Division
Naval Facilities Engineering Command
Lester, Pennsylvania
Contract No. N62472-86-D-1282

Prepared by:
TRC Environmental Corporation
5 Waterside Crossing
Windsor, Connecticut 06095

May 1993

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TRC Environmental Corporation

Naval Station Newport

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DESIGN ANALYSIS
INTERIM REMEDIAL ACTION
TANKS 53 AND 56 - TANK FARM 5
NETC, NEWPORT, RHODE ISLAND

90% DESIGN FINAL SUBMISSION

Prepared for:

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Windsor, Connecticut

TRC Project No. 12773-Q41-02

May 1993

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* Bound Separately

1.0 INTRODUCTION

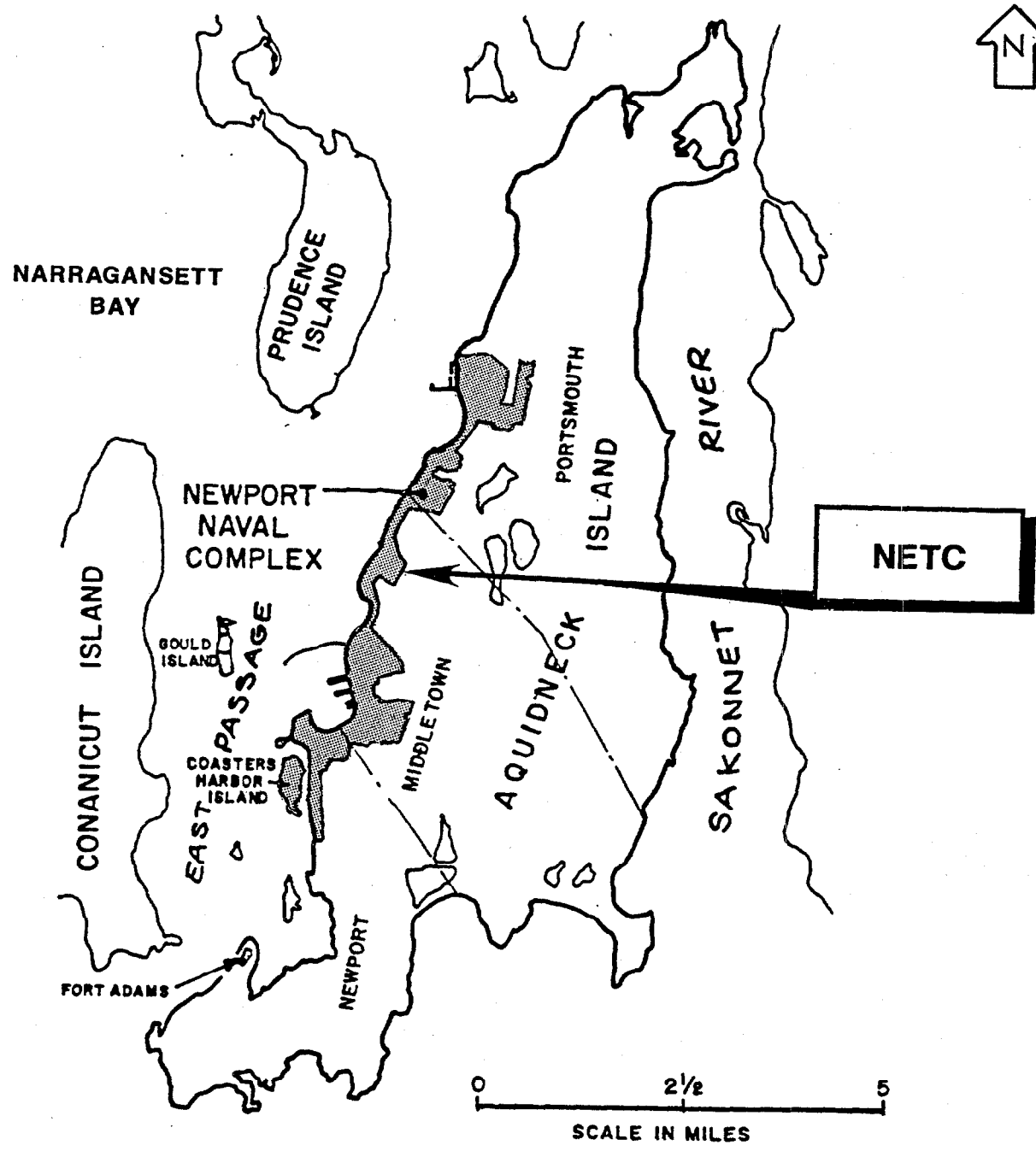
1.1 Project Location and Site Data

The Interim Remedial Action ground water extraction and treatment project location is Tank Farm Five in the vicinity of underground storage tanks 53 and 56 at the Naval Education and Training Center (NETC) in Newport, Rhode Island. Leaking underground oil storage tanks have resulted in contamination to the ground water system necessitating remediation.

NETC Newport is approximately 1,400 acres in size, with portions of the facility located in Newport, Middletown, and Portsmouth, Rhode Island. The site is approximately 60 miles south of Boston and 25 miles southeast of Providence. The facility layout is long and narrow, following the shoreline of Aquidneck Island for nearly six miles (see Figure 1). Tank Farm Five is located in the central portion of the facility, in the town of Middletown, Rhode Island (see Figure 2).

The 85-acre tank farm is the site of eleven underground storage tanks (USTs) numbered 49 through 59. Tanks 53 and 56 are located in the western portion of the Tank Farm Five site (see Figure 3). Each tank is constructed of prestressed concrete and has a capacity of 60,000 barrels (2.52 million gallons each). The tanks are approximately 116 feet in diameter and 33 feet deep. Each tank is covered by approximately four feet of soil and is surrounded by a ring drain which consists of a 12-inch reinforced concrete drain pipe located within a permeable backfill approximately four feet wide. The drain is connected to a sump pump to remove ground water from the backfill area, thereby preventing tank damage or tank flotation.

A paved road provides access to the site, passing between the tank locations in a loop. Other facilities on-site include the recently constructed Fire Fighting Training Area, a small building which was used as an



SOURCE: INITIAL ASSESSMENT STUDY (ENVIRODYNE, 1983)

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NAVAL EDUCATION AND TRAINING CENTER — NEWPORT RHODE ISLAND

FIGURE 1.

NAVAL EDUCATION AND TRAINING CENTER VICINITY MAP

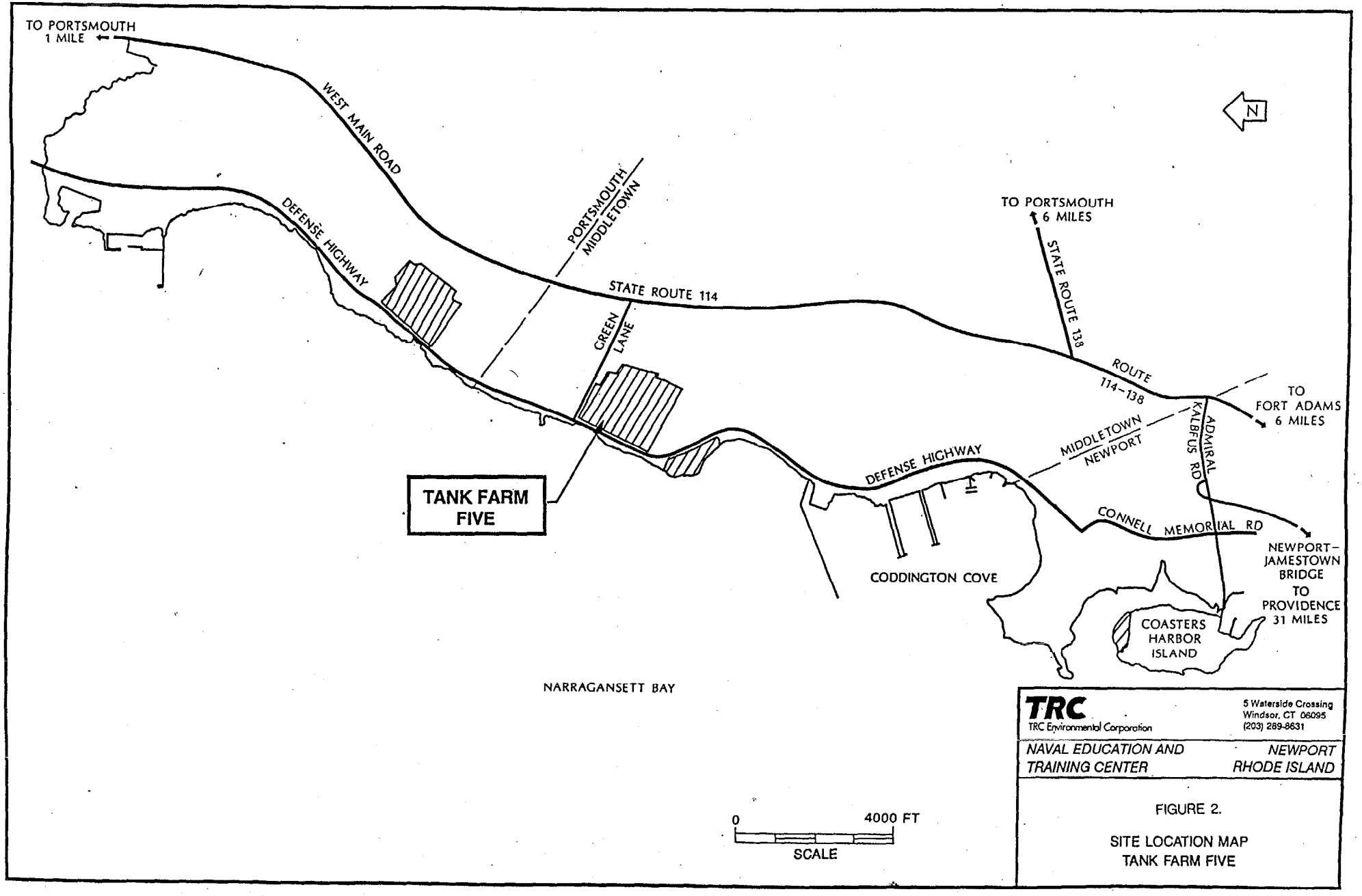

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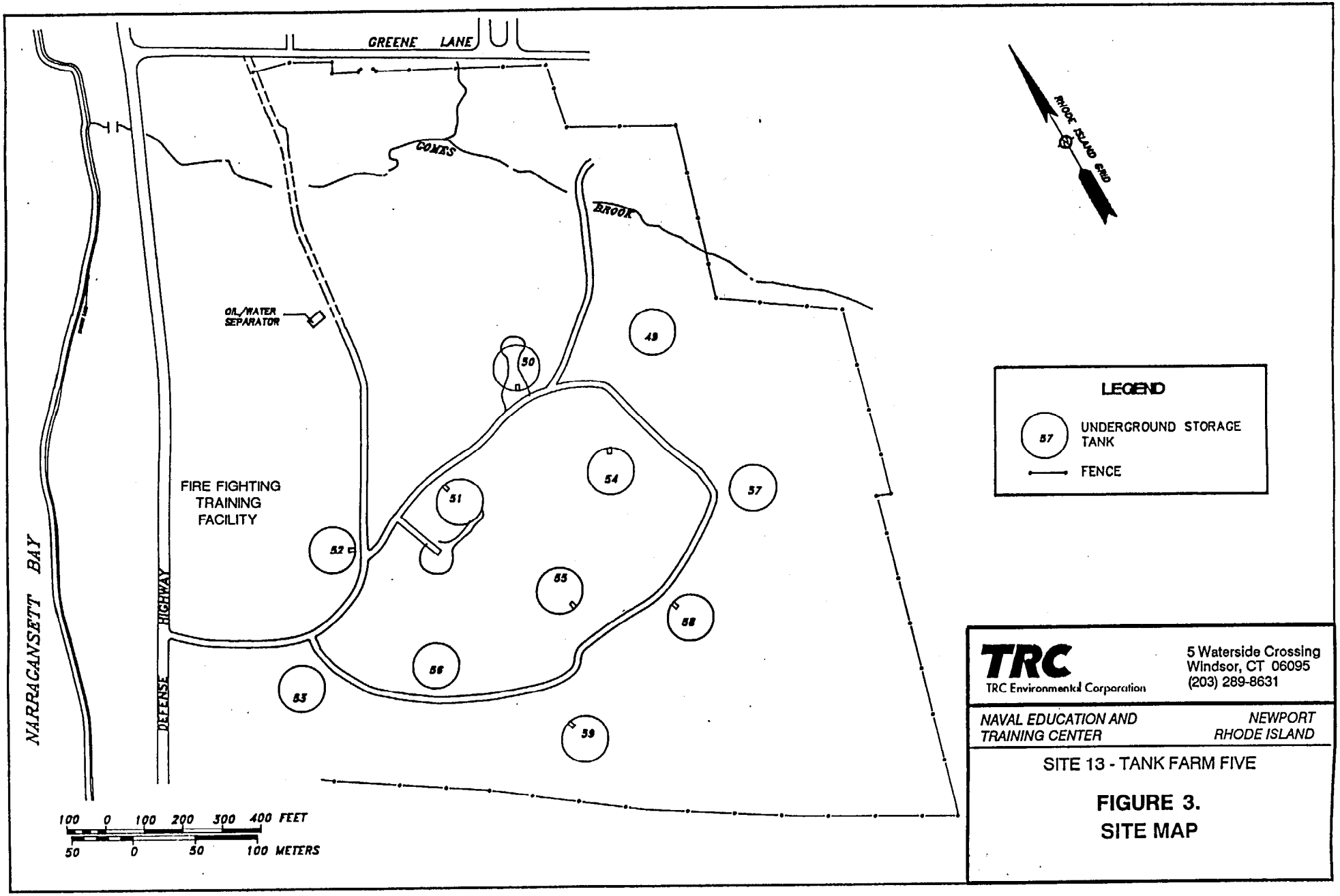
FIGURE 2.

SITE LOCATION MAP
TANK FARM FIVE



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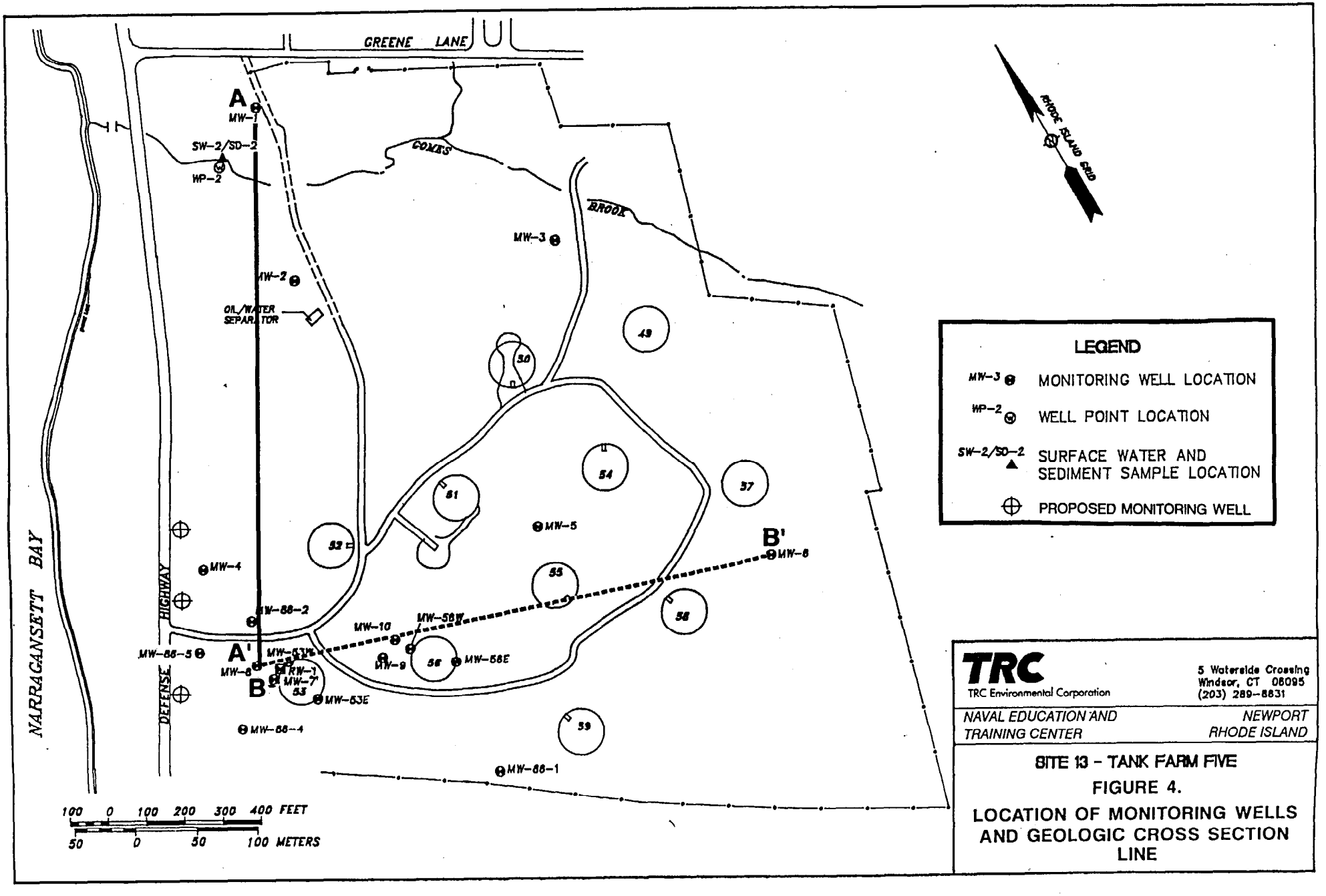
SITE 13 - TANK FARM FIVE

FIGURE 3.
SITE MAP

electrical substation, and a concrete structure apparently used as an oil-water separator. The Fire Fighting Training Area occupies approximately 3 acres in the western portion of the site and is surrounded by a chain-link fence. Gomes Brook crosses the northern portion of the site, and discharges to the Narragansett Bay. Topography generally slopes to the west and north. The central portion of the site in which the tanks are located is gradually sloping and well-drained. During periods of heavy rainfall, runoff from the site was observed to accumulate at the point where Defense Highway crosses Gomes Brook. Ponded water was also observed in a marshy area in the eastern corner of the site. The site is vegetated with grass, brush and some trees. Tank Farm Five is bordered to the west by Defense Highway, to the south by a cemetery, to the east by residences and to the north by Greene's Lane.

The overburden materials at the site consist of a fill layer around the tanks and native sand and silt, glacial till. The till was encountered in all site borings, ranging in thickness from 1 to 21 feet. The till directly overlies bedrock which consists of gray, highly weathered to competent, slightly metamorphosed shale with quartz lenses. A considerable zone (up to 22 feet) of weathered bedrock overlies the competent bedrock (see Figures 4, 5, 6 and 8).

Ground water flow direction for the shallow ground water at Tank Farm Five is generally to the northwest, towards Narragansett Bay in the southern portion of the site, including the area in which Tanks 53 and 56 are located (see Figure 7). In the northern part of the site, ground water flow is to the north, towards Gomes Brook. Piezometer and surface water level measurements indicate that Gomes Brook is a gaining stream (receives discharge from the ground water). Aquifer hydraulic conductivity values were determined from aquifer slug and pump tests. The hydraulic conductivity performed during the



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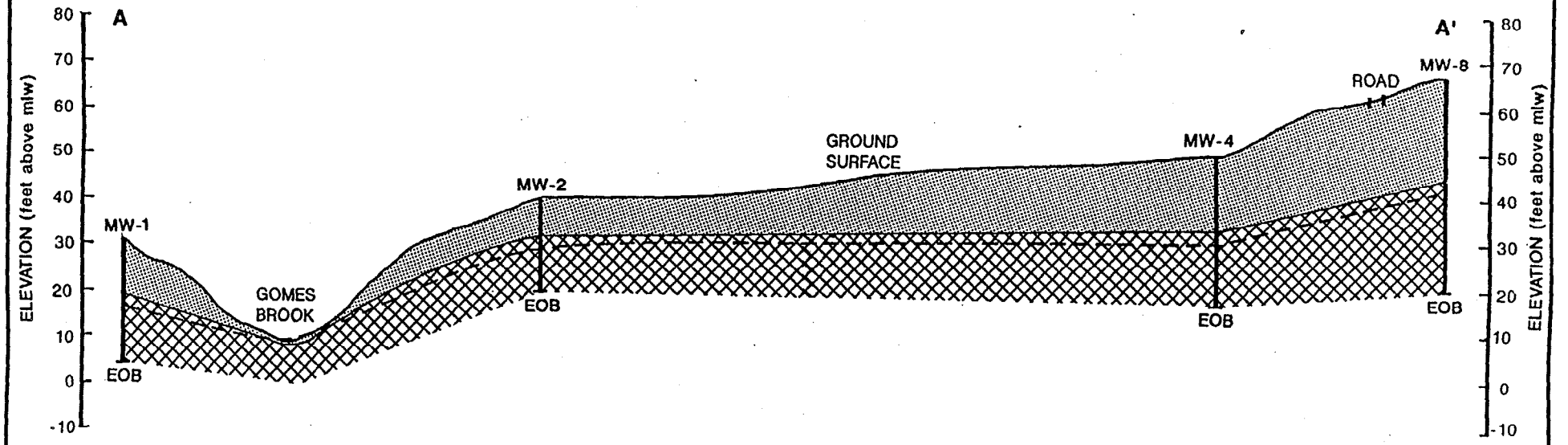
SITE 13 - TANK FARM FIVE

FIGURE 4.

LOCATION OF MONITORING WELLS AND GEOLOGIC CROSS SECTION LINE



LEGEND

TILL (SAND & SILT)

SHALE (WEATHERED TO COMPETENT)

EOB - END OF BORING

GROUND WATER TABLE (01/31/91)

0 200 FT

HORIZONTAL SCALE

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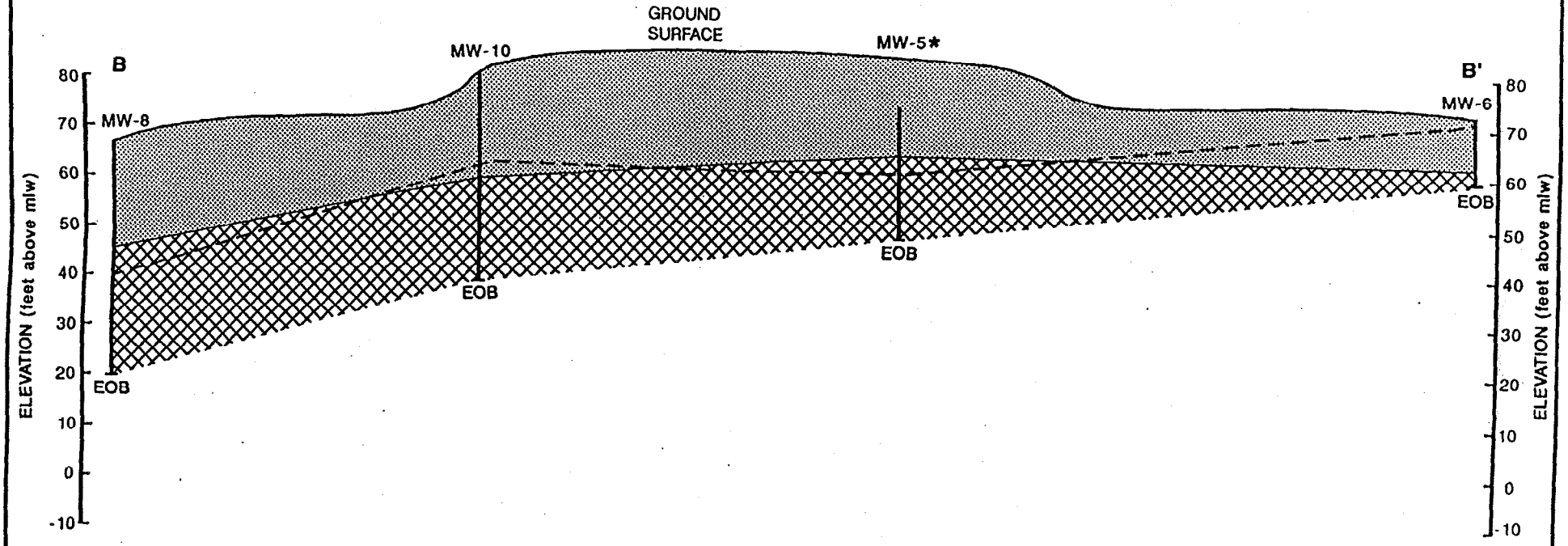
FIGURE 5.

GEOLOGIC CROSS SECTION LINE A-A'



LEGEND

TILL (SAND & SILT)

SHALE (WEATHERED TO COMPETENT)

EOB - END OF BORING

GROUND WATER TABLE (01/31/91)

*NOTE: MW-5 IS OFF-SET 200 FT. TO THE NORTH OF THE CROSS SECTION LINE

0 200 FT

HORIZONTAL SCALE

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SITE 13 - TANK FARM FIVE

FIGURE 6.

GEOLOGIC CROSS SECTION LINE B-B'

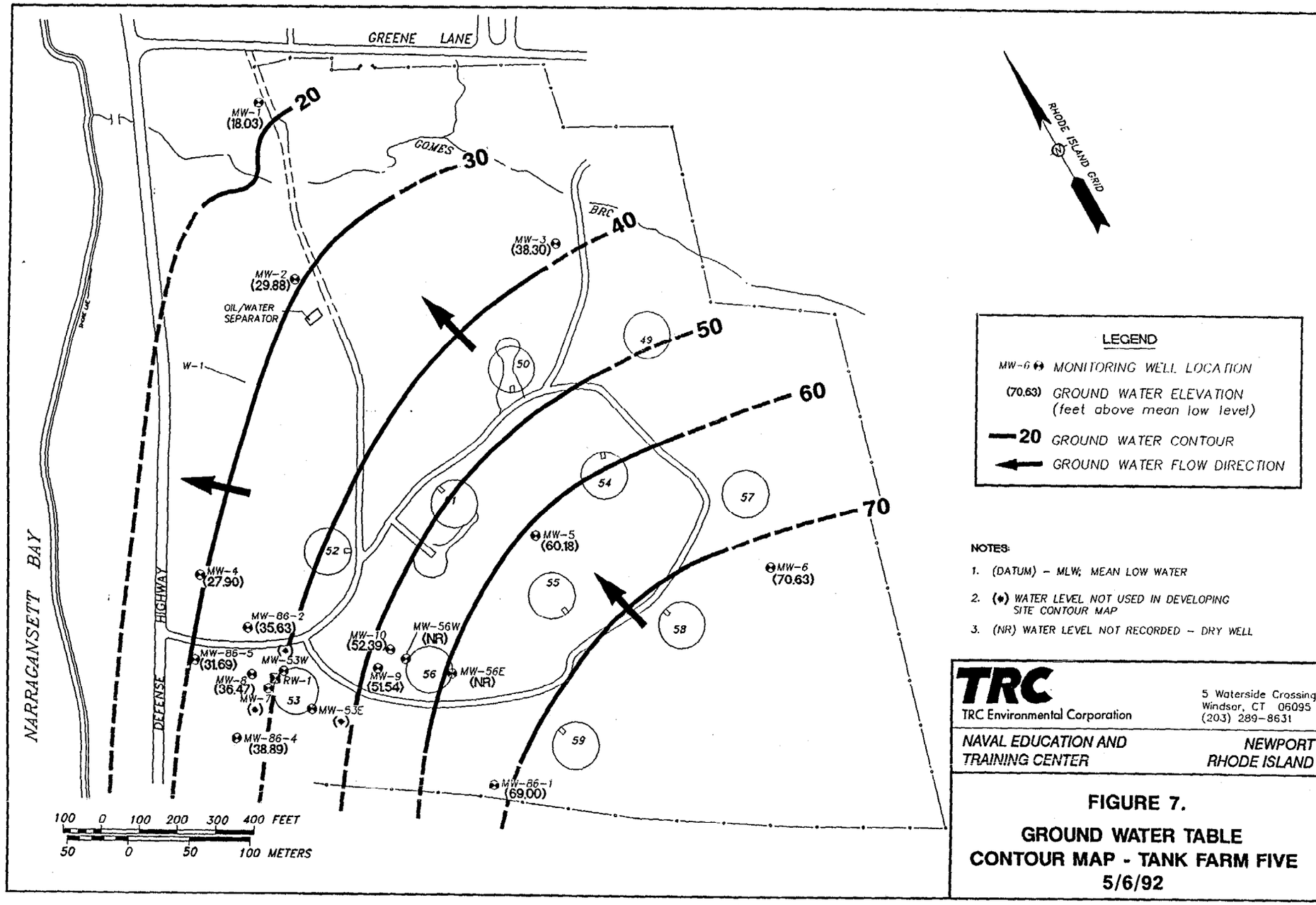

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FIGURE 7.

GROUND WATER TABLE CONTOUR MAP - TANK FARM FIVE

5/6/92

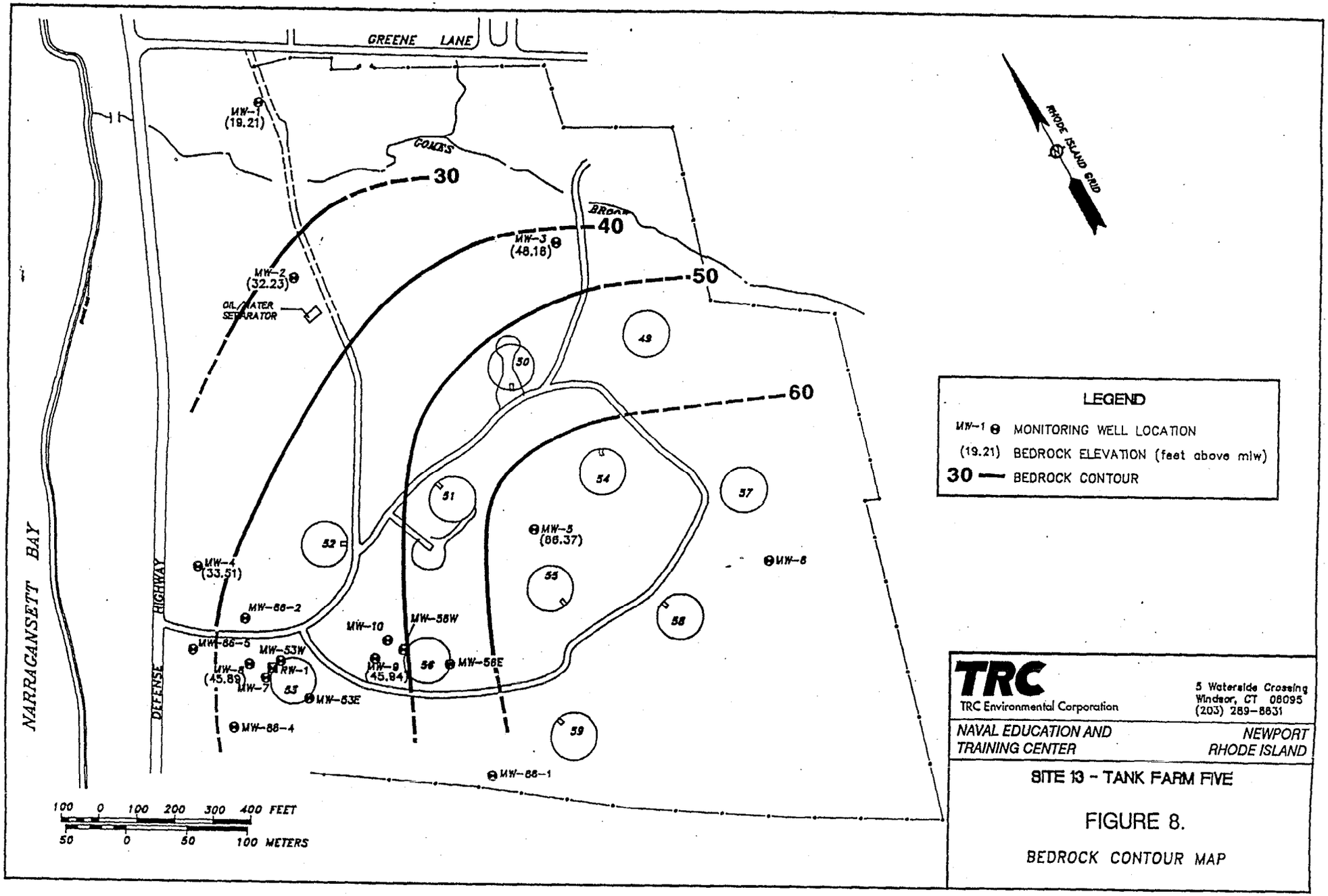
GREENE LANE
NARRAGANSETT BAY
DEFENSE HIGHWAY
COMB'S
BROOK
OIL/WATER SEPARATOR
RHODE ISLAND GRID
MW-1 (19.21)
MW-2 (32.23)
MW-3 (48.18)
MW-4 (33.51)
MW-5 (86.37)
MW-6
MW-7 (45.89)
MW-8
MW-9 (45.84)
MW-10
MW-53E
MW-53W
MW-56E
MW-56W
MW-66-1
MW-66-2
MW-66-4
MW-66-5
RW-1
30
40
50
60
49
50
51
52
53
54
55
56
57
58
59
100 0 100 200 300 400 FEET
50 0 50 100 METERS
LEGEND
MW-1 MONITORING WELL LOCATION
(19.21) BEDROCK ELEVATION (feet above mlw)
30 BEDROCK CONTOUR
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FIGURE 8.
BEDROCK CONTOUR MAP

Remedial Investigation on five wells screened in the shallow, weathered bedrock (with the exception of one well screened in till overburden) ranged from 0.16 to 0.21 ft/day. Two subsequent pump tests performed for the Interim Remedial Action on a well screened in the shallow weathered bedrock yielded hydraulic conductivities ranging from 0.14 ft/day to 5.95 ft/day (see Appendix B for detailed information). Horizontal hydraulic gradients in the shallow bedrock and till ranged from 0.0128 to 0.0398 ft/ft. Estimated average linear velocities for shallow ground water range from 0.017 to 0.05 ft/day. The contaminated ground water associated with Tanks 53 and 56 is currently flowing away from residential areas and is not discharging to or impacting any surface water bodies. The nearest residential areas are located approximately 1,400 feet to the north-northeast and 1,200 feet to the east-southeast. The current State of Rhode Island ground water classification applicable to the site is class GA-NA. GA indicates ground water sources which may be suitable for public or private drinking water without treatment. NA indicates areas of non-attainment which are known or presumed to be out of compliance with the ground water standards of the assigned classification. The nearest body of surface water off-site is the east passage of the Narragansett Bay. A more complete description of the site can be found in the Remedial Investigation Report on pages 1-23 and 1-24 (TRC, 1991).

Contamination was found in the area near Tanks 53 and 56 during previous investigations and available ground water sampling information indicates that a plume of contaminated ground water is migrating from this source area to the northwest towards Defense Highway.

Ground water sample results indicate the presence of volatile organic compounds (VOCs) and inorganics at levels exceeding the Maximum Contaminant Levels (MCLs), which are standards for drinking water established by the USEPA

under the 1986 Federal Safe Drinking Water Act. Contamination is currently limited to the area near Tank 53 and consists mainly of petroleum-related compounds and VOCs. A layer of floating free product was observed in the Tank 53 ring drain during monitoring well sampling. The presence of low levels of chlorinated hydrocarbons in a downgradient well indicates that migration of contamination is occurring. Base Neutral/Acid Extractable Organic Compounds (BNAs) were also detected from around Tank 53 at levels that do not exceed MCLs. While inorganic concentrations exceeded MCLs in all wells, the highest levels of inorganic analytes were detected in the central portion of the tank farm site.

1.2 Background

The Navy's first permanent activity at NETC Newport was in 1869 when the experimental Torpedo Station at Goat Island was established. In 1941, the Navy began construction of five tank farms with a total of 47 tanks to store fuel oils and other petroleum products with a total storage capacity of 2.8 million barrels. In subsequent peacetime years, on-site facilities were slowly disassembled.

Tank Farm 5 was constructed in 1942 and 1943 and was used for fuel storage from World War II to 1974. In 1975, the Navy began using Tanks 53 and 56 for used oil storage as part of an oil recovery program. Between 1975 and 1982, Tanks 53 and 56 contained used oil for alternate use as heating fuel. In 1982, RIDEM adopted hazardous waste regulations which were applicable to the waste oils in Tanks 53 and 56. Sampling of the water, oil, and sludge in the tanks was conducted in 1983. The sample results indicated that the oil phase in both tanks was hazardous due to the presence of elevated concentrations of lead. The sludge layer in both tanks was also determined to be hazardous due

to the presence of elevated concentrations of lead, cadmium, chromium, barium, mercury, and silver. In addition, the water in Tank 56 was found to contain dissolved hydrocarbon compounds. In 1985, results of ground water samples collected from monitoring wells installed in the ring drains of both tanks revealed the presence of several chlorinated and aromatic hydrocarbons and trace concentrations of mercury. Cadmium was also detected in one ground water sample from the ring drain of Tank 56. Subsequent investigatory activities conducted in 1986 confirmed the presence of VOCs in the Tank 53 ring drain and in the ground water 150 feet downgradient of Tank 53.

On September 10, 1985, NETC was issued a Hazardous Waste Facility Permit by the RIDEM. In addition to permitting the two hazardous waste storage areas, the permit stated that Tanks 53 and 56 were to be removed and closed in accordance with hazardous waste regulations, as well as RIDEM requirements for underground storage tanks for oil and hazardous substances.

On November 21, 1989, NETC Newport was placed on the USEPA's National Priorities List (NPL). Private-sector NPL sites are eligible for funding from the national environmental trust fund called Superfund. Investigation and cleanup of DOD sites, such as NETC Newport, are funded through the Defense Environmental Restoration Account (DERA).

1.3 Remedial Investigations

In January 1990, oil was observed leaking out of the gauging chamber of Tank 53 and onto the ground. Although the actual cause of the release was unknown, it was suspected that it may have resulted from, or been compounded by, construction projects underway in Tank Farm 5 close to Tank 53. RIDEM issued an Immediate Compliance Order which required the Navy to remove the contents of Tank 53, begin remediation of contaminated ground water and soils

surrounding the tank, and initiate an investigation to determine the extent of oil contamination in the vicinity of Tanks 53 and 56.

In the spring of 1990, TRC Environmental Corporation (TRC) installed additional monitoring wells and collected soil, water, and tank content samples to determine the presence and extent of contamination in and around Tanks 53 and 56. The oil product samples contained high concentrations of chlorinated and aromatic hydrocarbons, base/neutral/acid extractable compounds (BNAs) and several metals. Water samples from both tanks contained detectable concentrations of chlorinated and aromatic hydrocarbons, semi-volatile organics, and several heavy metals. Surface soil samples showed low concentrations of petroleum hydrocarbons and lead. Five soil boring samples contained detectable concentrations of both BNAs and petroleum hydrocarbons. Ground water sample results indicated the presence of floating hydrocarbon product and ground water contaminated with chlorinated and aromatic hydrocarbons and polynuclear aromatic hydrocarbons in the vicinity of Tank 53.

Pursuant to RIDEM tank closure requirements in 1992, the Navy completed the removal of the sludge, oil and water layers from Tanks 53 and 56. After removal of the tanks contents, the tank walls were steam-cleaned. An air stripping system with activated carbon was constructed to treat the tank's water contents as well as the contaminated ground water as it was removed from around the tanks. With the completion of this work in 1992, the air stripping system was removed. Confirmatory samples (to verify steam cleaning operations) of concrete from inside the tanks have been analyzed for Toxicity Characteristic Leaching Potential (TCLP) and have been found to be below detection levels.

Several pumping wells were installed around these two tanks prior to removal of their contents to avoid tank damage and potential tank flotation

due to hydrostatic pressure from adjacent ground water. A sump pump, activated by an increase in hydrostatic pressure, was installed to remove ground water from the ring drains around the tanks during periods of high ground water flow, e.g., heavy rainfall. An air stripping system with activated carbon was constructed to treat the tank's water contents as well as the contaminated ground water as it was removed from around the tanks. With the completion of this work in 1992, the air stripping system was removed.

Presently, ground water from the ring drains is being pumped and transferred to another nearby tank, pending approval of a permit modification with the City of Newport for discharge into their wastewater treatment plant.

Remediation of soil contamination around Tanks 53 and 56 is being addressed as part of the Resource Conservation and Recovery Act (RCRA) tank closure activities previously discussed. The Navy has recently initiated an investigation that will determine the horizontal and vertical extent of soil contamination. This information will be utilized to proceed with soil remediation in accordance with RIDEM's tank closure requirements.

The Phase I RI Report is currently being finalized. This report addresses the investigation activities conducted and findings to date at Tank Farm Five. The general purposes of the overall investigation were to:

- determine the presence, nature and extent of contamination resulting from historic site activities, including on-site and off-site impacts to soils, ground water, surface water, sediment and biota;
- identify potential contaminant migration routes;
- identify potential receptors of site contaminants; and
- characterize related environmental impacts and potential human health risks.

The Navy implemented a field sampling program to evaluate the ambient air and radiological surveys, geophysical surveys, soil gas surveys, and the collection and analysis of soil, sediment and ground water samples. A total of 88 samples were collected from Tank Farm Five during the Phase I RI.

Because of additional underground storage tanks (USTs) and an oil/water separator at the site, it was suspected that there may be additional sources of ground water contamination across Tank Farm Five. In addition to seven wells previously installed, six new monitoring wells were installed and sampled. The additional wells were added to more thoroughly investigate the nature and extent of ground water contamination and the effect of Gomes Brook on the site hydrology. Five additional wells were installed under tank closure investigation activities around Tanks 53 and 56 at Tank Farm Five.

1.4 Purpose

This interim remedial action is intended to contain ground water contamination in the vicinity of Tanks 53 and 56 and to prevent it from migrating further toward Narragansett Bay (see Figure 9). As part of this containment action the contaminated ground water pumped from the site will be treated on site and discharged into the public sanitary sewer system for conveyance to the local wastewater treatment facility. The contaminated ground water extraction will stabilize the migration of contaminants in the ground water until a final remedy has been chosen. An interim remedial action is not intended to be a final remedy but should be consistent with the final remedy chosen for that site.

Using the information gathered from site studies, the Navy identified objectives for the interim remedial action for cleanup of contaminated ground water around Tanks 53 and 56. The cleanup objectives are:

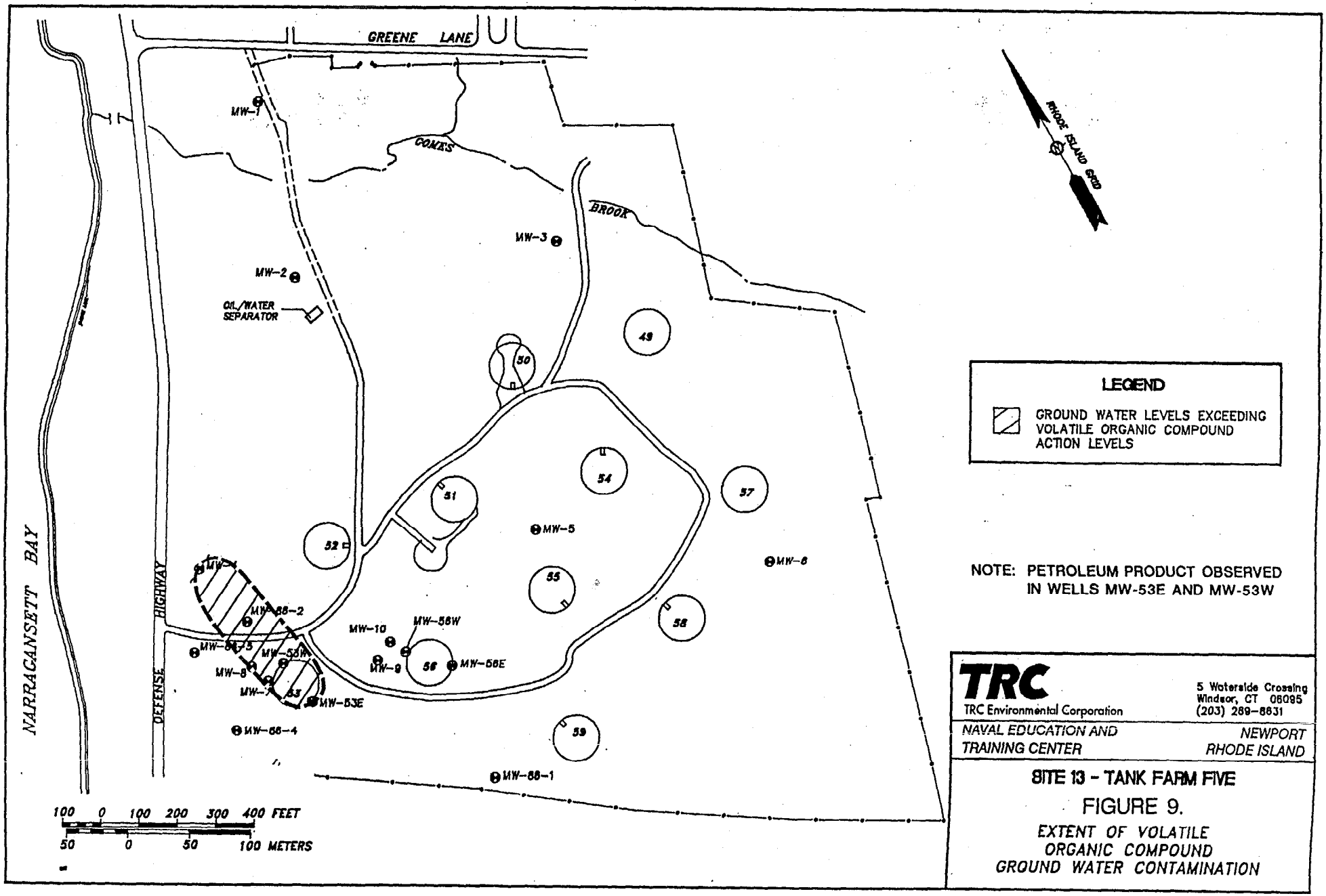
GREENE LANE
COMES
BROOK
MW-1
MW-2
MW-3
OIL/WATER SEPARATOR
MW-4
MW-5
MW-6
MW-7
MW-8
MW-9
MW-10
MW-53E
MW-53W
MW-55-2
MW-55-3
MW-56E
MW-56W
MW-55-1
MW-55-4
49
50
51
52
53
54
55
56
57
58
59
NARRAGANSETT BAY
DEFENSE HIGHWAY
RHODE ISLAND GRID
LEGEND
GROUND WATER LEVELS EXCEEDING VOLATILE ORGANIC COMPOUND ACTION LEVELS
NOTE: PETROLEUM PRODUCT OBSERVED IN WELLS MW-53E AND MW-53W
100 0 100 200 300 400 FEET
50 0 50 100 METERS
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FIGURE 9.
EXTENT OF VOLATILE ORGANIC COMPOUND GROUND WATER CONTAMINATION

1. to minimize further migration of the contaminated ground water;

2. to minimize any future negative impact to Gomes Brook and Narragansett Bay resulting from discharge of contaminated ground water;

3. to reduce the potential risk associated with the future ingestion of contaminated ground water; and

4. to reduce the time required for restoration of the aquifer.

As an interim step to meeting these objectives, the Navy proposes to extract and treat ground water from the most highly contaminated portion of the plume. This interim remedial action, which is intended to quickly respond to the plume of contamination in the vicinity of Tanks 53 and 56, will eventually become part of the overall remediation strategy for Tank Farm Five and NETC Newport as a whole. Therefore, the interim remedial action selected for ground water remediation must be consistent with the cleanup goals established for ground water site-wide and for the final remedy for the Tank Farm. The Navy's long-term cleanup goals for reducing contamination in ground water at NETC Newport are to meet drinking water Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs), or risk-based levels for compounds for which drinking water standards have not been set.

Because the purpose of the proposed action is to manage migration and begin cleanup of the contaminated ground water in the vicinity of Tanks 53 and 56, and is not meant to be the permanent remedy for Tank Farm 5, the Navy has assumed that the action will last for five years. After five years (or after the ROD for the final remedy), the Navy and the regulatory agencies will review the monitoring data and evaluate the effectiveness of the interim action. If the interim action is performing in accordance with project goals, the interim action could become part of the overall site remedy. If modifications need to be made to the extraction or treatment systems, they could be incorporated into the final remedy for the site.

2.0 REMEDIAL PLAN OVERVIEW

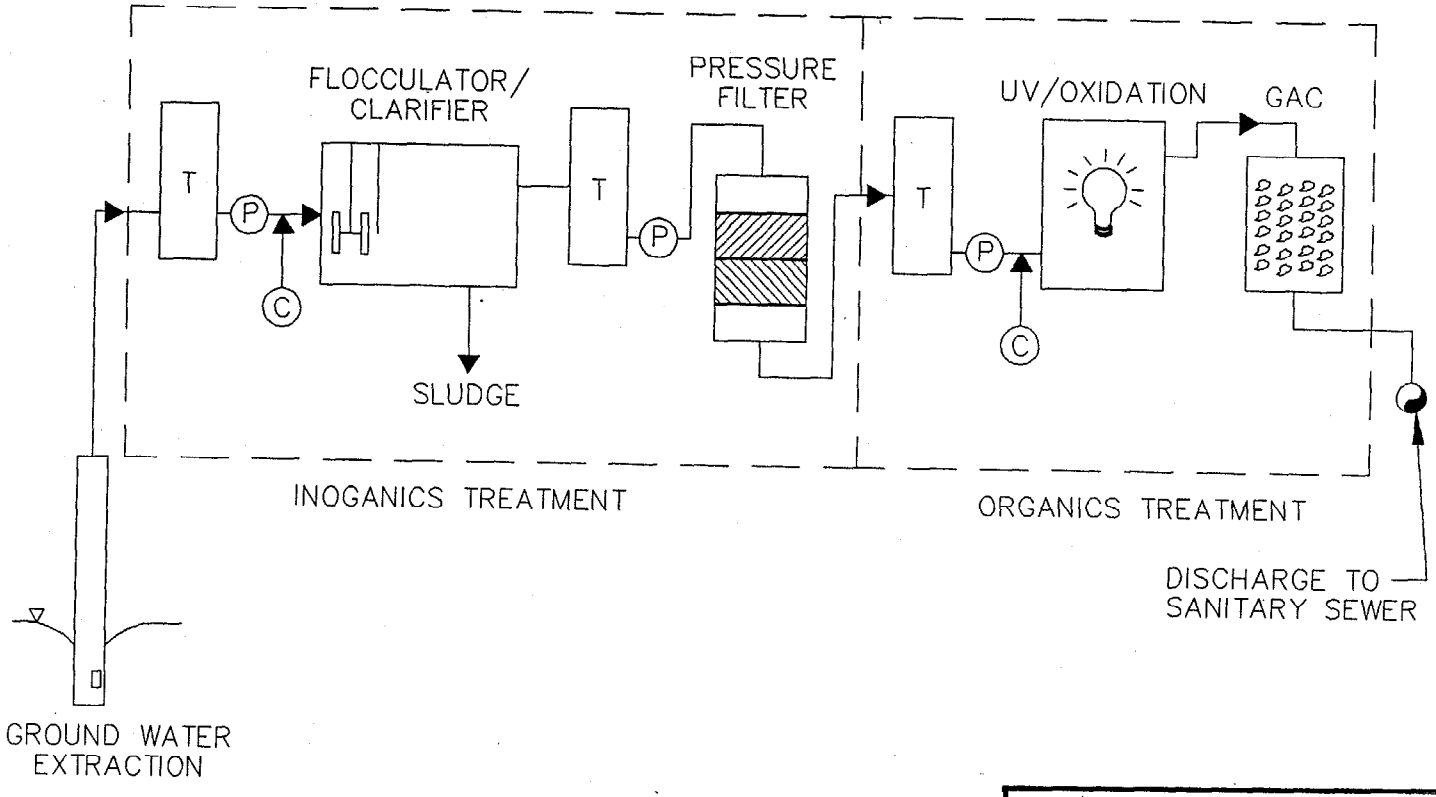
2.1 Summary

As detailed in the Record of Decision, the proposed treatment process includes removal of metals and volatile organic compounds (VOCs) from the water as follows: dissolved metals and inert suspended solids concentrations in the extracted ground water will be significantly reduced using a coagulation/filtration process so that they do not interfere with the VOC treatment process. Metals removal is accomplished by adding treatment chemicals to precipitate the metals out of solution and remove settleable solids in a clarifier tank. The remainder of the precipitated metals/solids will be separated from the water by passing the flow through filters. Following filtration, the water will be injected with an oxidant and pumped into a reactor exposing the contaminants to ultraviolet (UV) light to destroy VOCs. Additional treatment with a granular activated carbon adsorption system ensures that the discharge water meets the pretreatment standards of the publicly owned treatment plant (POTW) before discharge to the sanitary sewer. A block flow diagram of the treatment process is shown as Figure 10.

Existing wells and additional observation wells will be monitored during the interim remedial action to confirm the capture of contaminated ground water (see Figure 4). A monitoring program will be developed during final design and submitted for regulatory approval.

2.1.1 Discharge Requirements

Discussions with the City of Newport POTW officials indicate that the plant can accept the predicted minor hydraulic and chemical loading from this Interim Remedial Action. The POTW has established pretreatment standards for inorganic contaminants and a limit of 2.0 mg/l for "Total Toxic Organics" (EPA



KEY

T = SURGE TANK

P = PUMP

C = CHEMICAL FEED POINT

GAC = GRANULAR ACTIVATED CARBON

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NAVAL EDUCATION AND TRAINING CENTER

NEWPORT RHODE ISLAND

SITE 13 - TANK FARM FIVE
FIGURE 10.
TREATMENT PROCESS
BLOCK FLOW DIAGRAM

Methods 8240 and 8270 for Volatile and Semi-Volatile Organics, respectively). Table 1 shows the expected influent concentrations from the wells (by calculating an average value from the sampling results of wells in the area of proposed ground water extraction) and the concentration limits for discharge to the POTW.

2.2 Ground Water Extraction

Based on the results of previous sampling to determine the location of the contaminated plume, extraction wells have been located at the leading edge to control further downgradient migration. Additionally, a row of extraction wells has been sited adjacent to the downgradient side of Tank 53 to intercept contaminant migration (see Figure 9).

Pump test results and capture zone modeling have determined the spacing and predicted withdrawal rates of the extraction wells. Data from the aquifer testing and modeling indicates a well spacing of 10-22 feet will yield a flow range of 0.25 to two gallons per minute (gpm) from each well. Based on this information, eight extraction wells have been planned along the downgradient extent of the plume and five extraction wells near Tank 53 to a depth of 100 feet producing a predicted combined pumping rate of 3.3 to 26 gpm. (Detailed information regarding ground water extraction is contained in the Aquifer Testing and Modeling Report in Appendix B). After well construction, the Contractor will be required to perform a pumping test to determine maximum and optimum well yields.

The extracted ground water will be discharged from each well with an electric submersible pump to a common collector main flowing to the treatment building.

TABLE 1

CONTAMINANT CONCENTRATIONS AND TREATMENT REQUIREMENTS

Contaminant	Average Predicted Groundwater Concentrations	Predicted Effluent from Treatment Plant	Proposed Newport POTW Discharge Limits
Inorganics (mg/l)			
Aluminum	26	<5.0	5.0
Arsenic	0.02	0.02	2.0
Barium	0.05	0.05	2.0
Beryllium	--	--	2.0
Cadmium	--	--	0.8
Chromium	0.06	0.06	3.0
Cobalt	0.10	0.10	2.0
Copper	0.05	0.05	1.0
Lead	0.04	0.04	0.1
Mercury	0.001	0.001	0.5
Nickel	0.07	0.07	3.0
Selenium	--	--	2.0
Silver	0.02	0.02	3.0
Vanadium	0.04	0.04	2.0
Zinc	0.24	0.24	1.2
Total Suspended Solids	400	30	285
BOD	2	2	230
pH	6.2	6	5.5-10.0

TABLE 1

(Continued)

Contaminant	Average Predicted Groundwater Concentrations	Predicted Effluent from Treatment Plant	Proposed Newport POTW Discharge Limits
Total Toxic Organics (µg/l)			
Vinyl Chloride	<1	<1	---
Methylene Chloride	18	<14	---
Acetone	15	<10	---
1,1-Dichloroethane	17	<10	---
1,2-Dichloroethene	60	<1	---
Chloroform	<1	<1	---
1,1,1-Trichloroethane	107	<75	---
Trichloroethene	75	<1	---
Tetrachloroethene	28	<1	---
Benzene	12	<1	---
Toluene	11	<1	---
Ethylbenzene	29	<2	---
Xylenes	147	<10	---
Naphthalene	16	<1	---
2-methylnaphthalene	58	<1	---
Total Toxic Organics	700	150	2,000
Other Organics			
Di-n-Butylphthalate	8	<1	---
Butylbenzylphthalate	2	<1	---
Bis(2-Ethylhexyl)Phthalate	53	<5	---

2.3 Inorganic Contaminants Treatment

The extracted ground water will empty into an atmospheric pressure equalization tank. A caustic hydroxide solution will be added to raise the pH to ≈8.5 producing conditions where metals become less soluble and easier to precipitate as solids. A transfer pump will deliver the ground water to a flocculator/clarifier (F/C) treatment unit. In the pressure line, a flocculent, coagulant and oxidizing agent will be injected to enhance particle formation and break down any chelated metals that are complexed with organic compounds that would not precipitate otherwise.

Bench scale testing of the metals treatment process will be required of the equipment manufacturer to optimize the chemical loading requirements. It may be possible to reduce the coagulant feed rate because the high iron concentration may produce particles suitable for flocculation. Hydrogen peroxide has been selected as the oxidizing agent because it will already be on-site for use with the UV/oxidation system and because of its strong oxidizing capabilities. The feed rate will be optimized during system operation.

A rectangular F/C unit utilizing upflow inclined plate settling has been selected for the high relative settling rates and compact design. A clarifier is necessary because of the high suspended solids, iron and other metals that exist in the ground water that must be removed. Paddles in the flocculator zone will slowly mix the chemicals and precipitates of metal hydroxides will form. Settleable solids will collect on the clarifier bottom to be pumped to a sludge thickening tank. A filter press will be batched as necessary to reduce sludge volume for disposal. The sludge will be tested using the TCLP extraction method to determine if it has to be disposed of as hazardous waste. Filtrate water from the sludge process will be recycled back to the head of the treatment system.

Clarified water from the F/C unit will flow to a storage tank necessary to prime a transfer pump prior to pressure filtration.

Dual media pressure filters will remove unsettleable and other fine particles necessary to meet discharge limits and final pretreatment requirements to prevent fouling the UV/oxidation process. When the solids have clogged the filter bed to the extent that head loss becomes unacceptable, a backwash process will be initiated with high reverse flow rates to remove the particles. The backwashed water will be recycled to the influent equalization tank via the sludge thickener tank to remove any solids.

Alternative means of metals contaminant removal were considered during the screening design process. Most notably the membrane filtration technology offered the benefits of physical removal with minimal chemical addition and therefore less sludge generation. However, the relatively high solids loading rate of the water to be treated results in an operating inefficiency to the extent that the proposed "conventional" removal is estimated to be more cost effective.

2.4 Organic Contaminants Removal

Filtered water from the inorganics treatment process will then be cycled through the ultraviolet light chamber where hydrogen peroxide will be added for oxidation of organics. In this high energy (predicted 30 kilowatt demand) environment, hydroxyl radicals are formed which act to break down organic contaminants into simpler, non-hazardous substances such as carbon dioxide, water, salts, sulfates, nitrates, and organic and inorganic acids. UV/oxidation works well to destroy most organic contaminants but requires significantly longer residence times with aliphatic alcohols and saturated hydrocarbon compounds such as 1,1,1-trichloroethane and methylene chloride.

Rather than oversize the UV reactor for these few compounds resulting in excessive electrical energy useage, a granular activated carbon (GAC) absorption system will be utilized to reduce the remaining untreated organics concentration. The UV/oxidation unit will be sized to remove nearly all of the VOCs from the water. The usage rate of GAC is expected to be relatively low thereby minimizing the frequency of carbon changeout and regeneration.

2.5 Treated Water Discharge

The final treated ground water will be tested for compliance with the POTW pretreatment permit standards and discharged by gravity to the sanitary sewer in the vicinity of the Fire Fighter Training Center.

2.6 Support Facilities

All treatment units and systems will be equipped with appropriate instruments and controls to protect equipment, monitor flow and treatment efficiency. Control interlocks will shut down the entire treatment system for safety and issue an alarm signal in a breakdown condition.

Extraction wells will be equipped with float controls to protect against motor burnout and flow meters and throttling valves to enable measurement and adjustment of flow.

The treatment system will be housed in a pre-engineered metal building with heating and ventilation to minimize exterior environmental stress that can affect treatment processes.

Fire protection will be provided sufficiently by the existing water main and fire hydrant system near the treatment building. Fire extinguishers will be placed appropriately in the building. There are no flammable chemicals which will be used inside the building. This coupled with the small size

(<5,000 sq. ft.), low occupancy and fire resistive construction eliminates the need for a sprinkler system.

2.7 Monitoring Plans

Routine sampling and analysis of the ground water in and adjacent to the contaminant plume will be performed on a quarterly basis to monitor the changes and reduction in contaminant concentrations. Water level measurements in observation wells will be used to monitor the effective capture zone.

Well flow rates will be recorded to enable a hydraulic analysis of the ground water system and determine necessary adjustments.

Sampling ports will be installed between treatment unit process steps to enable testing for monitoring and optimization of chemical feed and loading rates. A laboratory setup at the treatment plant will be equipped to allow routine chemical analysis (spectrophotometry). Complete testing of the treatment plant effluent is proposed to be performed at an approved laboratory for compliance with the POTW permit conditions. Table 2 lists the proposed analytes to be tested:

TABLE 2
TREATMENT SYSTEM EFFLUENT MONITORING

Parameter	Frequency	Parameter	Frequency
Cadmium	Monthly	Sulfides	Monthly
Chromium (trivalent)	Monthly	Sulfates	Monthly
Chromium (hexavalent)	Monthly	Floating Oil	Monthly
Copper	Monthly	Fluoride	Monthly
Gold	Monthly	Mercuric Chloride	Monthly
Lead	Monthly	Phenols	Monthly
Nickel	Monthly	Total Toxic Organics	Monthly
Silver	Monthly	Suspended Solids	Monthly
Tin	Monthly	BOD	Monthly
Zinc	Monthly	pH	Monthly
Cyanides	Monthly		

The proposed monitoring location is the sampling port at the end of the treatment system inside the new treatment building.

2.8 Free Product Source Recovery

Free product has been identified in the ring drain at Tank 53 during the remedial investigation phase. The record of decision does not require source removal of free product and the current design package does not include any provision for free product recovery.

A separate study is underway regarding clean-up options for source removal at Tank 53. A draft report presenting findings and recommendations is in preparation.

2.9 Permit Review

The Navy has applied for an Industrial User Discharge Permit for the Newport POTW (see Appendix C). Table 3 contains an evaluation of other permits that may be applicable to the Interim Remedial Action.

TABLE 3

GROUND WATER TREATMENT AT TANK FARM FIVE – NETC NEWPORT
PRELIMINARY PERMIT EVALUATION MATRIX

Permit Category	Permit Name	Regulatory Citation	Permit Description	Project Applicability
AIR	a. Equipment Registration	RI Air Pollution Control Regulations No. 9, 3/93	Registration of air pollution control devices	No
	b. Permit to Construct, Install, Modify or Operate	RI Air Pollution Control Regulations No. 9, 3/93	Permitting of air pollution control devices	No
HEALTH & SAFETY	a. OSHA Confined Space Permit	29 CFR 1910.146(b)(23)(i) through (iii)	Entry into a "permitted" confined space	No
	b. Hazard Operation Permit	U.S. Department of the Navy, Fire Division	Burning, cutting, or welding operations	No
	c. Gas–Free Certification	U.S. Department of the Navy, Fire Division	Burning, cutting, or welding in a hazardous area	No
UNDERGROUND STORAGE TANKS	a. Underground Storage Tank Registration Notification	Section 8.00 of the RI Regulations for Underground Storage Facilities used for Petroleum Products and Hazardous Wastes	Registration of underground petroleum and hazardous waste storage tanks	No
WATER MANAGEMENT	a. RI Pollutant Discharge Elimination System (RIPDES) Permit	Chapters 46–12, 42–17.1, and 42–35 of the RI General Laws, 1956 as amended	Discharge of wastewater to a surface water body	No
	b. Order of Approval: RIPDES	Chapters 46–12, 42–17.1, and 42–35 of the RI General Laws, 1956 as amended	Emergency discharge of wastewater to surface water body	No
	c. General Permit for Stormwater Discharges Associated with Construction Activity	Rule 31 of the RIPDES Regulations	Discharge of stormwater via a point source at construction sites which disturb > 5 acres of land	No
	d. Order of Approval: Underground Injection Control (UIC)	Chapter 46–17 and 46–12 of the RI General Laws, 1956 as amended	Discharge of wastewater to ground water	No
	e. Newport POTW Industrial User Permit	**Chapter 46–12, 42–17.1, and 42–35 of the RI General Laws, 1956 as amended**	**Discharge of wastewater to POTW**	**Yes**
WETLANDS	a. Application for Preliminary Determination	Rule 4.00 of Section 2–1–18 through 2–1–24 of the RI General Laws	Determination whether wetlands requirements are or are not applicable to this project.	No
	b. Permit to Alter Freshwater Wetlands	Rule 8.00 of Section 2–1–18 through 2–1–24 of the RI General Laws	Permit which is issued through RIDEM to allow alteration of wetlands	No

3.0 BASIS OF DESIGN AND CALCULATIONS

3.1 Introduction

Design criteria and calculations are presented for the various design disciplines involved in the Ground Water Treatment Interim Remedial Action, all in accordance with Navy Guidance Manuals.

3.2 Civil Engineering Design

3.2 Civil Engineering Design

I. Basis of Design

Civil engineering aspects of the project include ground water extraction wells and piping, water supply and sanitary sewer system extension, paving, drainage and miscellaneous site improvements. The extraction wells are a major component of the Interim Remedial Action to control the migration of contaminated ground water. The other civil engineering facilities are minor in scope and primarily in support of the treatment system and building services.

The project site is a west-facing wooded hillside of moderate slope (3-10%) falling to Narragansett Bay. Adjacent to the site the Navy constructed a Fire Fighting Training Center (FFTC) in 1990.

An existing 8-inch and 12-inch diameter water supply system at the site was upgraded for the construction of the FFTC and will be adequate to serve the minor additional demands of this IRM Treatment System. A pressure/flow test has been conducted at the site to obtain design data for water service and fire protection capacity.

Sanitary sewers were extended to the FFTC from the existing NETC sewer system. Sewage from this area flows by gravity in an 8-inch diameter line to a pump station located near the intersection of Greene's Lane and Defense Highway. The gravity flow portion of the system is presently working satisfactorily with no reported problems and should be adequate to serve the minor additional demands of the IRA Treatment System. An 8-inch diameter PVC pipe with manholes is planned to connect to the existing sanitary sewer at the FFTC. The pump station/force main portion of the sanitary sewer system is currently under study with upgrades expected.

Storm water run-off will be diverted away from the Treatment Building with the use of grass swales designed for a 100-year storm. The Treatment Building has been located between Tanks 53 and 56 in an area clear of underground utilities. The location was selected so that treated water effluent can flow by gravity to the existing sanitary sewer at the FFTC. It is also proximate to other zones of ground water contamination that may be included in the treatment process in the future.

An asphalt concrete driveway extension is planned to the Treatment Building area so that plant operators and suppliers can gain all weather access. There is space for two vehicles and one delivery truck in the parking area. A gravel roadway is shown traversing remote portions of the site to allow access and maintenance of the extraction wells.

The Treatment Building area will be protected by a 7-foot high chain link fence. Fire alarms at the site will be wired to the central fire station.

Designs are based on standard professional engineering practice and criteria from the Navy Design Manuals and Handbooks, American Society of Civil Engineers, American Water Works Authority, Water Environment Federation (formerly Water Pollution Control Federation), etc. The following references have been used for design:

- Navy
  - DM-5.02 Hydrology and Hydraulics
  - DM-5.03 Drainage Systems
  - DM-5.4 Pavements
  - DM-5.5 General Provisions for Geometric Streets
  - MH 1005/7 Water Supply Systems
  - MH 1005/9 Industrial and Oily Wastewater Control
  - MH 1005/12 Fencing, Gates and Guard Towers
  - DM-5.14 Ground Water Pollution Control
- TR-16 "Guides for the Design of Wastewater Treatment Works," 1980, New England Interstate Water Pollution Control Commission
- National Fire Protection Association Fire Flow Requirements
- American Water Works Association Standards

II. Civil Engineering Calculations

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b. Water Supply System	4
c. Sanitary Sewer System	5
d. Storm Water Management	6
e. Roadways	8
f. Site Improvements	9

TRC
TRC Environmental Corporation

INTERIM REMEDIAL ACTION
TANK FARM FIVE
NETC, NEWPORT, RI
CONTRACT No. N62472-92-C-0056

SHEET NO. 1 OF 9
PROJECT NO. 12773
DATE 19 JAN 1993
BY R. Nault
CHK'D REV 30 APR 1993

SUBJECT a. GROUND WATER EXTRACTION WELL SYSTEM

Based on preliminary well data, the flow rate from each well is expected to be 0.25 - 2 gpm with a spacing of 10-22 ft. The screen interval will extend from the unconsolidated overburden into the fractured bedrock to a depth of 100 ft ±. The ground water table fluctuates between 20 - 30 ft below the surface and a drawdown of 60 ft. can be provided.

The wells will be 4" ϕ with stainless steel screen and sand pack. A stainless steel electric submersible well will be installed and each well will have a valve pit containing a flow meter, throttling valve, pressure gage and sampling tap.

13 individual wells will be tied into a common polyethylene collector pipe to the treatment building. Pipe size has been determined such that velocity will not exceed 5 feet per second (min size = 1½") (as per Mil Handbook 1005/7) to reduce energy losses and control water hammer. A table can be established for plastic pipe:

PIPE SIZE	MAXIMUM FLOW
1"	15 GPM
1 ¼"	22 GPM
1½"	32 GPM
2"	52 GPM
3"	115 GPM
4"	200 GPM

SUBJECT a. GROUND WATER EXTRACTION WELL SYSTEM

The predicted combined flow rate from the wells is 3 to 26 GPM. The higher flow has been used for design.

NOMINAL WELL PUMP SYSTEM CURVE

The most remote well will be examined with the highest flow value in each segment used as a worst case scenario:

Static Head

Ground Elevation = 50
Water Table during pumping = -30 ±
Equalization Tank discharge elevation = 83

STATIC HEAD = 83-(-30) = 113'

Dynamic Head

Component	Equiv Pipe Length	Flow	Head Loss
1" Check Valve	7'		
1" Well Riser	100'		
1" 90° bend	6'		
1" Globe valve	28'		
1" pipe	10'		
	151' - 1"ϕ	2 GPM	0.6 ft
Water Meter		2 GPM	2.0 ft
1 1/2" pipe	480'		
(7) 45° bends	14 } Σ=494'	16 GPM	2.3 ft

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TRC Environmental Corporation

SHEET NO. 3 OF 9

PROJECT NO.

DATE 19 JAN 1993

BY R Nault

CHK'D Rev 30 APR 1993

SUBJECT a. GROUND WATER EXTRACTION WELL SYSTEM

2" pipe	360'			
(3) 45° bends	8			
(5) 90° bends	28'	$\Sigma = 411'$	26 GPM	5.3 ft
Check Valve	13			
Globe Valve	2			

DYNAMIC HEAD = 10.2 ft

WELL SYSTEM CURVE

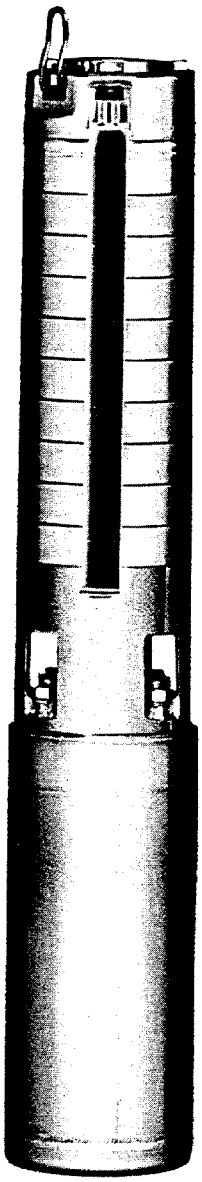
FLOW	TOTAL HEAD
0	113 ft
2 GPM	123 ft

Even the smallest Grundfos Pump Model (1/3 hp) can deliver 2 GPM at 240' TDH. Thus this type pump will work here and in all other site wells. The throttling valve will have to be closed somewhat to induce additional head loss to produce the desired steady flow from the wells. The well level sensors will be arranged such that a minimum drawdown at the wells of 8 feet ± will provided. This will ensure that sufficient gradient exists at all times to provide plume capture. The pumps will operate at a minimum flow of 1.2 gpm ± to protect them from burnout which may result in cycling if the aquifer cannot yield the pump flow.

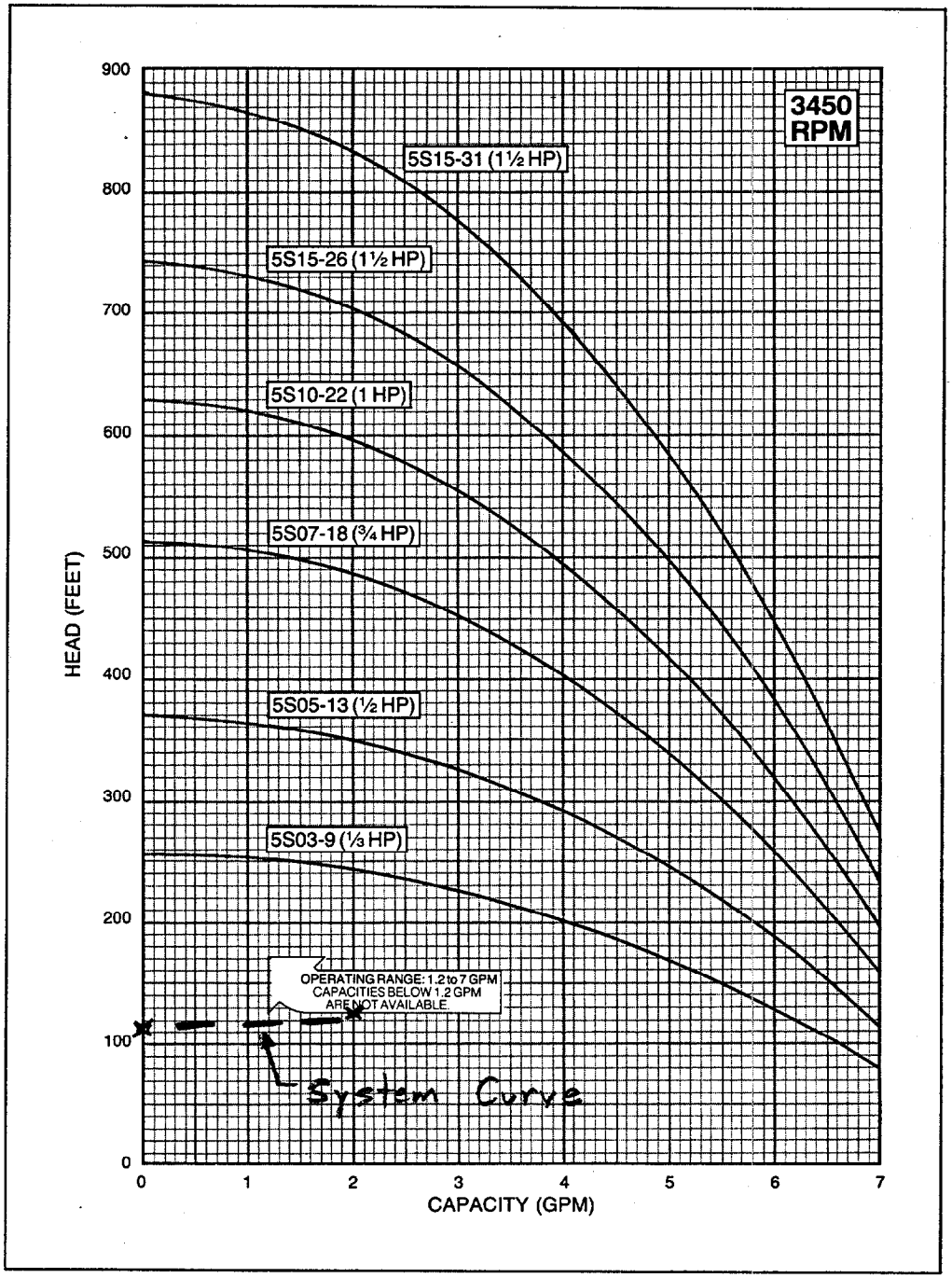
MODEL 5S — 5 GPM — GRUNDFOS

FLOW RANGE
1.2 to 7 GPM

PUMP OUTLET
1" NPT



PERFORMANCE CURVES



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	LENGTH (INCHES)	WIDTH (INCHES)	APPROX. UNIT SHIPPING WT. (LBS.)
5S03-9	⅓	24 3/8	3 15/16	27
5S05-13	½	28 ½	3 15/16	31
5S07-18	¾	33 ¼	3 15/16	34
5S10-22	1	37 ⅛	3 15/16	42
5S15-26	1 ½	42	3 15/16	46
5S15-31	1 ½	47 7/8	3 15/16	58

Specifications are subject to change without notice.

Friction Loss

TECHNICAL DATA

PLASTIC PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	3/8"		1/2"		3/4"		1"		1 1/4"		1 1/2"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
1	60	4.25	1.85	1.38	.60	.356	.155	.11	.048				
2	120	15.13	6.58	4.83	2.10	1.21	.526	.38	.164	.10	.044		
3	180	31.97	13.9	9.96	4.33	2.51	1.09	.77	.336	.21	.090	.10	.043
4	240	54.97	23.9	17.07	7.42	4.21	1.83	1.30	.565	.35	.150	.16	.071
5	300	84.41	36.7	25.76	11.2	6.33	2.75	1.92	.835	.51	.223	.24	.104
6	360			36.34	15.8	8.83	3.84	2.69	1.17	.71	.309	.33	.145
8	480			63.71	27.7	15.18	6.60	4.58	1.99	1.19	.518	.55	.241
10	600			97.52	42.4	25.98	11.27	6.88	2.99	1.78	.774	.83	.361
15	900					49.68	21.6	14.63	6.36	3.75	1.63	1.74	.755
20	1,200					86.94	37.8	25.07	10.9	6.39	2.78	2.94	1.28
25	1,500							38.41	16.7	9.71	4.22	4.44	1.93
30	1,800									13.62	5.92	6.26	2.72
35	2,100									18.17	7.90	8.37	3.64
40	2,400									23.55	10.24	10.70	4.65
45	2,700									29.44	12.80	13.46	5.85
50	3,000											16.45	7.15
60	3,600											23.48	10.21

FROM GOULD'S PUMPS ENGINEERING DATA GUIDE

Friction Loss

TECHNICAL DATA

PLASTIC PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	2"		2½"		3"		4"		6"		8"		10"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
6	360	.10	.044												
8	480	.17	.073												
10	600	.25	.108	.11	.046										
15	900	.52	.224	.22	.094										
20	1,200	.86	.375	.36	.158	.13	.056								
25	1,500	1.29	.561	.54	.234	.19	.083								
30	1,800	1.81	.786	.75	.327	.26	.114								
35	2,100	2.42	1.05	1.00	.436	.35	.151	.09	.041						
40	2,400	3.11	1.35	1.28	.556	.44	.191	.12	.052						
45	2,700	3.84	1.67	1.54	.668	.55	.239	.15	.064						
50	3,000	4.67	2.03	1.93	.839	.66	.288	.17	.076						
60	3,600	6.60	2.87	2.71	1.18	.93	.406	.25	.107						
70	4,200	8.83	3.84	3.66	1.59	1.24	.540	.33	.143						
80	4,800	11.43	4.97	4.67	2.03	1.58	.687	.41	.180						
90	5,400	14.26	6.20	5.82	2.53	1.98	.861	.52	.224						
100	6,000			7.11	3.09	2.42	1.05	.63	.272	.08	.036				
125	7,500			10.83	4.71	3.80	1.65	.95	.415	.13	.055				
150	9,000					5.15	2.24	1.33	.580	.18	.077				
175	10,500					6.90	3.00	1.78	.774	.23	.102				
200	12,000					8.90	3.87	2.27	.985	.30	.130				
250	15,000							3.36	1.46	.45	.195	.12	.051		
300	18,000							4.85	2.11	.63	.275	.17	.072		
350	21,000							6.53	2.84	.84	.367	.22	.095		
400	24,000									1.08	.471	.28	.121		
500	30,000									1.66	.720	.42	.182	.14	.059
550	33,000									1.98	.861	.50	.219	.16	.071
600	36,000									2.35	1.02	.59	.258	.19	.083
700	42,000											.79	.343	.26	.112
800	48,000											1.02	.443	.33	.143
900	54,000											1.27	.554	.41	.179
950	57,000													.46	.198
1000	60,000													.50	.218

Friction Loss

TECHNICAL DATA

STEEL PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	3/8"		1/2"		3/4"		1"		1 1/4"		1 1/2"		2"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
1	60	4.30	1.85	1.86	.80	.26	.11								
2	120	15.00	6.45	4.78	2.06	1.21	.52	.38	.16						
3	180	31.80	13.67	10.00	4.30	2.50	1.08	.77	.33						
4	240	54.90	23.61	17.10	7.35	4.21	1.81	1.30	.56	.34	.15				
5	300	83.50	35.91	25.80	11.09	6.32	2.72	1.93	.83	.51	.22	.24	.10		
6	360			36.50	15.70	8.87	3.81	2.68	1.15	.70	.30	.33	.14	.10	.04
7	420			48.70	20.94	11.80	5.07	3.56	1.53	.93	.40	.44	.19	.13	.06
8	480			62.70	26.96	15.00	6.45	4.54	1.95	1.18	.51	.56	.24	.17	.07
9	540					18.80	8.08	5.65	2.43	1.46	.63	.69	.30	.21	.09
10	600					23.00	9.89	6.86	2.95	1.77	.76	.83	.36	.25	.11
12	720					32.60	14.02	9.62	4.14	2.48	1.07	1.16	.50	.34	.15
15	900					49.70	21.37	14.70	6.32	3.74	1.61	1.75	.75	.52	.22
20	1,200					86.10	37.02	25.10	10.79	6.34	2.73	2.94	1.26	.87	.37
25	1,500							38.60	16.60	9.65	4.15	4.48	1.93	1.30	.56
30	1,800							54.60	23.48	13.60	5.85	6.26	2.69	1.82	.78
35	2,100							73.40	31.56	18.20	7.83	8.37	3.60	2.42	1.04
40	2,400							95.00	40.85	23.50	10.11	10.79	4.64	3.10	1.33
45	2,700									30.70	13.20	13.45	5.78	3.85	1.66
70	4,200									68.80	29.58	31.30	13.46	8.86	3.81
100	6,000											62.20	26.75	17.40	7.48
150	9,000													38.00	16.34
200	12,000													66.30	28.51
250	15,000													90.70	39.00

Friction Loss

TECHNICAL DATA

STEEL PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	2½"		3"		4"		5"		6"		8"		10"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
10	600	.11	.05	.04	.01										
12	720	.15	.06	.05	.02										
15	900	.22	.09	.08	.03										
20	1,200	.36	.15	.13	.06										
25	1,500	.54	.23	.19	.08										
30	1,800	.75	.32	.26	.11										
35	2,100	1.00	.43	.35	.15										
40	2,400	1.28	.55	.44	.19										
45	2,700	1.60	.69	.55	.24										
70	4,200	3.63	1.56	1.22	.52	.35	.15								
100	6,000	7.11	3.06	2.39	1.03	.63	.27								
150	9,000	15.40	6.62	5.14	2.21	1.32	.57								
200	12,000	26.70	11.48	8.90	3.83	2.27	.98	.736	.32	.30	.13	.08	.03		
250	15,000	42.80	18.40	14.10	6.06	3.60	1.55	1.20	.52	.49	.21	.13	.06		
300	18,000	58.50	25.15	19.20	8.26	4.89	2.10	1.58	.68	.64	.28	.16	.07	.0542	.0235
350	21,000	79.20	34.06	26.90	11.57	6.72	2.89	2.18	.94	.88	.38	.23	.10	.0719	.0312
400	24,000	103.00	44.70	33.90	14.71	8.47	3.68	2.72	1.18	1.09	.47	.279	.1211	.0917	.0398
450	27,000	130	56.42	42.75	18.55	10.65	4.62	3.47	1.51	1.36	.59	.348	.1510	.114	.0495
500	30,000	160	69.44	52.50	22.78	13.00	5.64	4.16	1.81	1.66	.72	.424	.1840	.138	.0599
550	33,000	193	83.76	63.20	27.43	15.70	6.81	4.98	2.16	1.99	.86	.507	.2200	.164	.0712
600	36,000	230	99.82	74.80	32.46	18.60	8.07	5.88	2.55	2.34	1.02	.597	.2591	.192	.0833
650	39,000			87.50	37.97	21.70	9.42	6.87	2.98	2.73	1.18	.694	.3012	.224	.0972
700	42,000			101	43.83	25.00	10.85	7.93	3.44	3.13	1.36	.797	.3459	.256	.1111
750	45,000			116	50.34	28.60	12.41	9.05	3.93	3.57	1.55	.907	.3936	.291	.1263
800	48,000			131	56.85	32.40	14.06	10.22	4.44	4.03	1.75	1.02	.4427	.328	.1424
850	51,000			148	64.23	36.50	15.84	11.50	4.99	4.53	1.97	1.147	.4978	.368	.1597
900	54,000			165	71.61	40.80	17.71	12.90	5.60	5.05	2.19	1.27	.5512	.410	.1779
950	57,000			184	79.85	45.30	19.66	14.30	6.21	5.60	2.43	1.41	.6119	.455	.1975
1000	60,000			204	88.54	50.20	21.79	15.8	6.86	6.17	2.68	1.56	.6770	.500	.2170

Friction Loss

TECHNICAL DATA

COPPER PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	3/8"		1/2"		3/4"		1"		1 1/4"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
1	60	6.2	2.7	1.8	.8	.39	.17				
2	120	19.6	8.5	6.0	2.6	1.2	.50				
5	300			30	13	5.8	2.5	1.6	.7		
7	420			53	23	11.0	4.8	3.2	1.4	2.2	.95
10	600					19.6	8.5	5.3	2.3	3.9	1.7
15	900					37.0	16.0	9.9	4.3	6.2	2.7
18	1,080					55.4	24.0	16.1	7.0	6.9	3.0
20	1,200							18.5	8.0	10.4	4.5
25	1,500							27.7	12.0	14.3	6.2
30	1,800							39.3	17.0	18.7	8.1
35	2,100							48.5	21.0	25.4	11.0
40	2,400									30.0	13.0
45	2,700									39.3	17.0

Friction Loss

TECHNICAL DATA

COPPER PIPE:

FRICTION LOSS PER 100 FT.

GPM	GPH	1½"		2"		2½"		3"		4"	
		Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.	Ft.	Lbs.
15	900	2.1	.9								
18	1,080	3.2	1.4								
20	1,200	3.9	1.7								
25	1,500	5.3	2.3	1.5	.64						
30	1,800	7.6	3.3	2.1	.90						
35	2,100	10.2	4.4	2.8	1.2						
40	2,400	13.2	5.7	3.5	1.5	1.2	.52				
45	2,700	16.2	7.0	4.2	1.8	1.6	.67				
50	3,000	19.4	8.4	5.1	2.2	1.8	.80				
60	3,600	27.7	12.0	6.9	3.0	2.5	1.1	1.1	.47		
70	4,200	40.0	16.0	9.2	4.0	3.5	1.5	1.4	.60		
75	4,500	41.6	18.0	9.9	4.3	3.7	1.6	1.6	.70		
80	4,800	45.0	19.5	11.6	5.0	4.2	1.8	1.8	.80		
90	5,400	50.8	22.0	13.9	6.0	4.8	2.1	2.2	.95		
100	6,000			16.9	7.3	6.2	2.7	2.8	1.2		
125	7,500			25.4	11.0	8.6	3.7	3.7	1.6		
150	9,000			32.3	14.0	11.6	5.0	4.8	2.1	1.2	.51
175	10,500			41.6	18.0	16.2	7.0	6.9	3.0	1.7	.75
200	12,000			57.8	25.0	20.8	9.0	9.0	3.9	2.2	.95
250	15,000					32.3	14.0	13.9	6.0	3.5	1.5
300	18,000					41.6	18.0	18.5	8.0	4.6	2.0
350	21,000							32.3	14.0	5.8	2.5
400	24,000							39.3	17.0	7.2	3.1
450	27,000							44.0	19.0	9.2	4.0
500	30,000									11.1	4.8
750	45,000									23.1	10.0
1000	60,000									37.0	16.0

Friction Loss

TECHNICAL DATA

ALUMINUM PIPE:

RICTION LOSS IN FEET PER 100 FEET

PM	2" OD .05" Wall	3" OD .05" Wall	4" OD .063" Wall	5" OD .063" Wall	6" OD .063" Wall	7" OD .078" Wall	8" OD .094" Wall
5	.07						
10	.32	.04					
20	1.20	.15	.04				
0	2.58	.32	.08				
0	4.49	.56	.13	.04			
50	6.85	.85	.20	.07	.03		
0	9.67	1.21	.28	.09	.04		
'0	12.95	1.61	.38	.12	.05		
80	16.70	2.06	.49	.16	.06	.03	
90	20.80	2.58	.60	.20	.08	.04	
0	25.40	3.18	.74	.24	.10	.05	.03
20		4.51	1.06	.34	.14	.07	.04
140		6.00	1.41	.46	.19	.09	.05
0		7.76	1.82	.59	.24	.11	.06
0		9.67	2.27	.73	.30	.14	.07
200		11.83	2.78	.89	.36	.17	.09
0		14.12	3.31	1.07	.44	.20	.11
0		16.72	3.91	1.27	.52	.24	.13
260		19.42	4.56	1.47	.60	.28	.15
280		22.40	5.26	1.71	.69	.33	.17
0		25.45	5.98	1.93	.79	.37	.19
0			8.03	2.59	1.05	.50	.26
400			10.36	3.33	1.35	.64	.33

GPM	2" OD .05" Wall	3" OD .05" Wall	4" OD .063" Wall	5" OD .063" Wall	6" OD .063" Wall	7" OD .078" Wall	8" OD .094" Wall
450			12.90	4.15	1.69	.80	.41
500			15.73	5.07	2.06	.97	.50
550			19.12	6.16	2.50	1.18	.62
600			22.46	7.24	2.94	1.38	.72
650			26.10	8.42	3.41	1.62	.84
700				9.68	3.92	1.86	.97
750				11.05	4.46	2.11	1.10
800				12.48	5.03	2.38	1.24
850				13.95	5.64	2.67	1.39
900				15.65	6.35	2.98	1.56
950				17.35	7.02	3.32	1.73
1000				19.10	7.72	3.64	1.90
1100				22.85	9.22	4.37	2.27
1200				26.95	10.88	5.16	2.68
1300					12.62	5.96	3.10
1400					14.65	6.90	3.60
1500					16.67	7.87	4.07
1600					18.80	8.89	4.62
1700					20.95	9.95	5.16
1800					23.60	11.15	5.79
1900						12.35	6.42
2000						13.65	7.10

(Above table computed for Aluminum Pipe with Coupler)

RUBBER HOSE:

RICTION LOSS IN FEET PER 100 FEET

U.S. Gal. r Min.	ACTUAL INSIDE DIAMETER IN INCHES							
	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
15	70	23	5.8	2.5	.9	.2		
20	122	32	10	4.2	1.6	.5		
25	182	51	15	6.7	2.3	.7		
30	259	72	21.2	9.3	3.2	.9	.2	
40		122	35	15.5	5.5	1.4	.7	
50		185	55	23	8.3	2.3	1.2	
60		233	81	32	11.8	3.2	1.4	
70			104	44	15.2	4.2	1.8	
80			134	55	19.8	5.3	2.5	
90			164	70	25	7	3.5	.7
100			203	85	29	8.1	4	.9
125			305	127	46	12.2	5.8	1.4
150			422	180	62	17.3	8.1	1.6
175				230	85	23.1	10.6	2.5
200				308	106	30	13.6	3.2

U.S. Gal. Per Min.	ACTUAL INSIDE DIAMETER IN INCHES							
	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
250					162	44	21	4.9
300					219	62	28	6.7
350					292	83	39	9.3
400						106	49	11.8
500						163	74	17.1
600						242	106	23
700						344	143	30
800						440	182	40
900							224	51
1000							270	63
1250							394	100
1500							525	141
1750								185
2000								230

Friction Loss

TECHNICAL DATA

EQUIVALENT NUMBER OF FEET STRAIGHT PIPE FOR DIFFERENT FITTINGS

Size Of Fittings, Inches	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	5"	6"	8"	10"
90° Ell	1.5	2.0	2.7	3.5	4.3	5.5	6.5	8.0	10.0	14.0	15	20	25
45° Ell	0.8	1.0	1.3	1.7	2.0	2.5	3.0	3.8	5.0	6.3	7.1	9.4	12
Long Sweep Ell	1.0	1.4	1.7	2.3	2.7	3.5	4.2	5.2	7.0	9.0	11.0	14.0	
Close Return Bend	3.6	5.0	6.0	8.3	10.0	13.0	15.0	18.0	24.0	31.0	37.0	39.0	
Tee-Straight Run	1	2	2	3	3	4	5						
Tee-Side Inlet or Outlet or Pitless Adapter	3.3	4.5	5.7	7.6	9.0	12.0	14.0	17.0	22.0	27.0	31.0	40.0	
Ball or Globe Valve Open	17.0	22.0	27.0	36.0	43.0	55.0	67.0	82.0	110.0	140.0	160.0	220.0	
Angle Valve Open	8.4	12.0	15.0	18.0	22.0	28.0	33.0	42.0	58.0	70.0	83.0	110.0	
Gate Valve-Fully Open	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.7	2.3	2.9	3.5	4.5	
Check Valve (Swing)	4	5	7	9	11	13	16	20	26	33	39	52	65
In Line Check Valve (Spring) or Foot Valve	4	6	8	12	14	19	23	32	43	58			

Example:

(A) 100 ft. of 2" plastic pipe with one (1) 90° elbow and one (1) swing check valve.

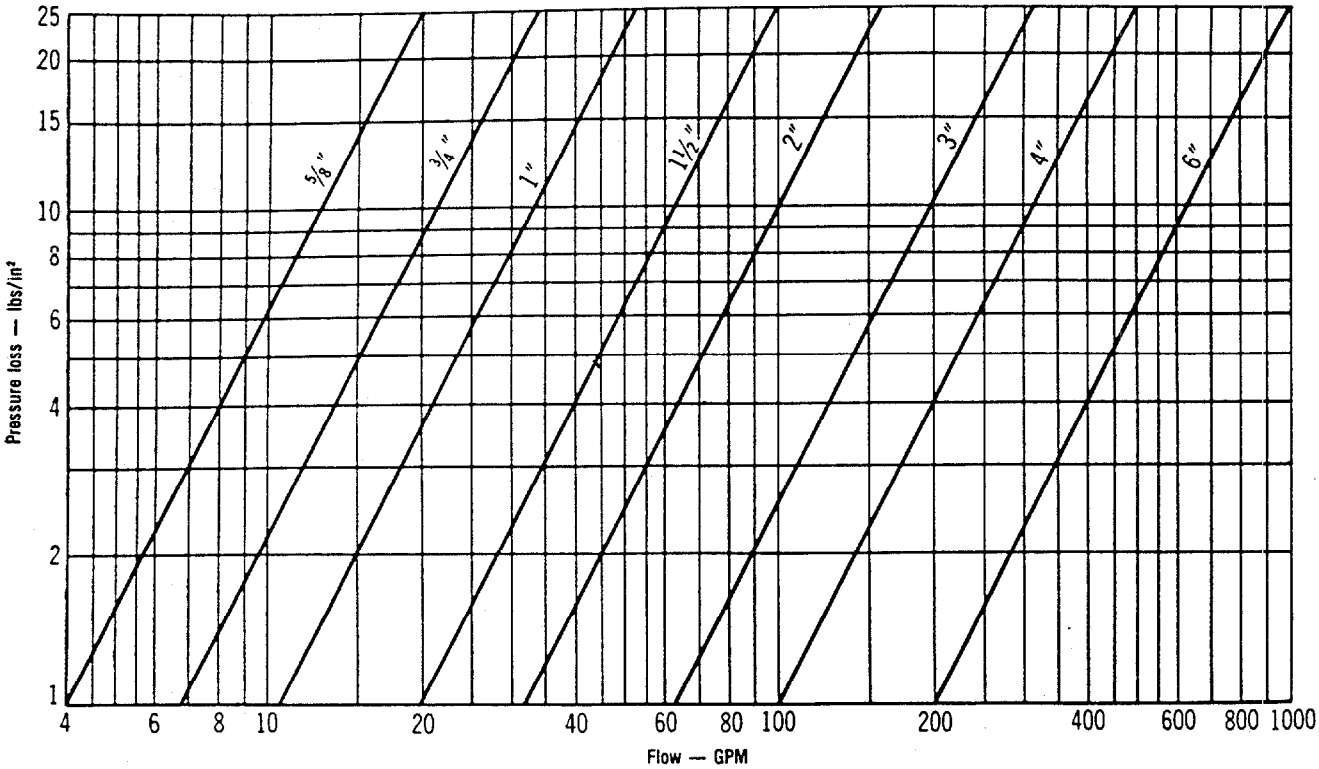
90° elbow — Equivalent to 5.5 ft. of straight pipe
Swing check — Equivalent to 13.0 ft. of straight pipe
100 ft. of pipe — Equivalent to 100.0 ft. of straight pipe
118.5 ft. = Total equivalent pipe

Figure friction loss for 118.5 ft. of pipe.

(B) Assume flow to be 80 GPM through 2" plastic pipe.

1. Friction loss table shows 11.43 ft. loss per 100 ft. of pipe.
2. In step (A) above we have determined total ft. of pipe to be 118.5 ft.
3. Convert 118.5 ft. to percentage 118.5 ÷ 100 = 1.185
4. Multiply 11.43
   x 1.185
   13.54455 or 13.5 ft. = Total friction loss in this system.

Figure 9 — Pressure losses in water meters



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SUBJECT b. Water Supply System

The new service line will be 1½" ϕ copper tubing. The existing 8" main to the FFTC will be wet-tapped and a corporation stop and curb stop/box will be installed. (Note that the FFTC main was selected instead of the closer Tank Farm main because the Tank Farm line is not often used which may result in water quality problems)

The service line will be routed to the treatment building where a reduced-pressure principle backflow preventer and water meter will be installed inside. The exterior line will have a minimum cover of 4'-2" which is below the extreme frost depth for NETC.

The projected building water use is:

Domestic
50 gpcd/worker/shift × 4 = 200 gpd

Clean-Up (Wash hose)
5 gpm × 20 min/day = 100 gpd

TOTAL = 300 gpd

The projected peak day flow (using a factor of 4)
PEAK DAY = 1,200 gpd

The projected instantaneous* flow = 25 gpm *see Plumbing Calcs

The water system flow test determined that the static hydraulic grade line in the area = Elev 243± Thus with the building at Elev 74 that results in a pressure head of 73 psi ±. The head loss in 260' of 1½" copper @ 25 gpm = 2.6 psi resulting in 70 psi ± at the building ✓

TRC
TRC Environmental Corporation

DATE 19 JAN 1993
BY R Nault
CHK'D REV 30 APR 1993

SUBJECT C. Sanitary Sewer System

An 8" ϕ PVC sanitary sewer line will be extended from the existing system to the Treatment Building. The minimum slope in the downstream line is 0.50 ft/100 ft to produce scour velocities of at least 2.5 feet per second.

Connection to the existing system will be made by core-drilling an existing manhole, re-forming the invert and sealing with a neopreme boot.

The predicted flow in the sanitary sewer system will be from the Treatment effluent and domestic wastewater:

Treatment Process 50 gpm × 1440 min/day	72,000 gpd
Domestic / Building Services	300 gpd
TOTAL	72,300 gpd

The capacity of an 8" ϕ line at minimum slope of 0.50 ft/100 ft is 600,000 gpd. The peak flow from the Treatment Building will be

Treatment Process × (1.2 pump factor) 72,000 gpd × 1.2	= 86,400 gpd
Domestic / Building (Peak Factor = 4) 300 gpd × 4	= 1,200 gpd
TOTAL =	87,600 gpd

∴ OK Peak Flow << Pipe Capacity

TRC
TRC Environmental Corporation

DATE 20 JAN 1992
BY R Nault
CHK'D REV 30 APR 1993

SUBJECT d. Storm Water Management

A swale will be constructed around the uphill side of the Treatment Building and roadway to divert water away. The swale has been sized for a 100 year storm event because of the hazard associated with chemical storage (per Mil Handbook 1005/3)

The swale will be vee-shaped with 4:1 side slopes so it can be mowed. It will have an effective depth of 1.5' and an allowable water depth of 1.0' to yield freeboard.

Hydrology - using the Rational Method $Q = C\,i\,A$

Two swales are proposed

Swale 1

Drainage Area, A = 0.93 acres C = 0.30 Woodland
Time of Concentration T_c = 25 min
300' of overland flow S = 3.3% Forest, Brush
150' of concentrated flow S = 6% Brush
Rainfall Intensity, i_1 = 3.9 in/hr from Chart

Peak Flow, $Q_1 = 0.30 \times 3.9 \times 0.93 = 1.1$ cfs

Swale 2

Drainage Area, A = 0.63 acres C = 0.30
Time of Concentration, T_c = 25 min
(same flow conditions as above)
Rainfall Intensity, i_2 = 3.9 in/hr

Peak Flow, $Q_2 = 0.30 \times 3.9 \times 0.83 = 0.7$ cfs

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TRC Environmental Corporation

DATE 20 JAN 1993
BY R Nault
CHK'D RCI 30 APR 1993

SUBJECT d. Storm Water Management

Hydraulics

Using Mannings Equation

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

V = velocity
n = roughness coefficient
R = hydraulic radius
S = slope

For Swale 1 Slope = 1% = 0.01 Q = 1.1 cfs
grass ∴ n = 0.030

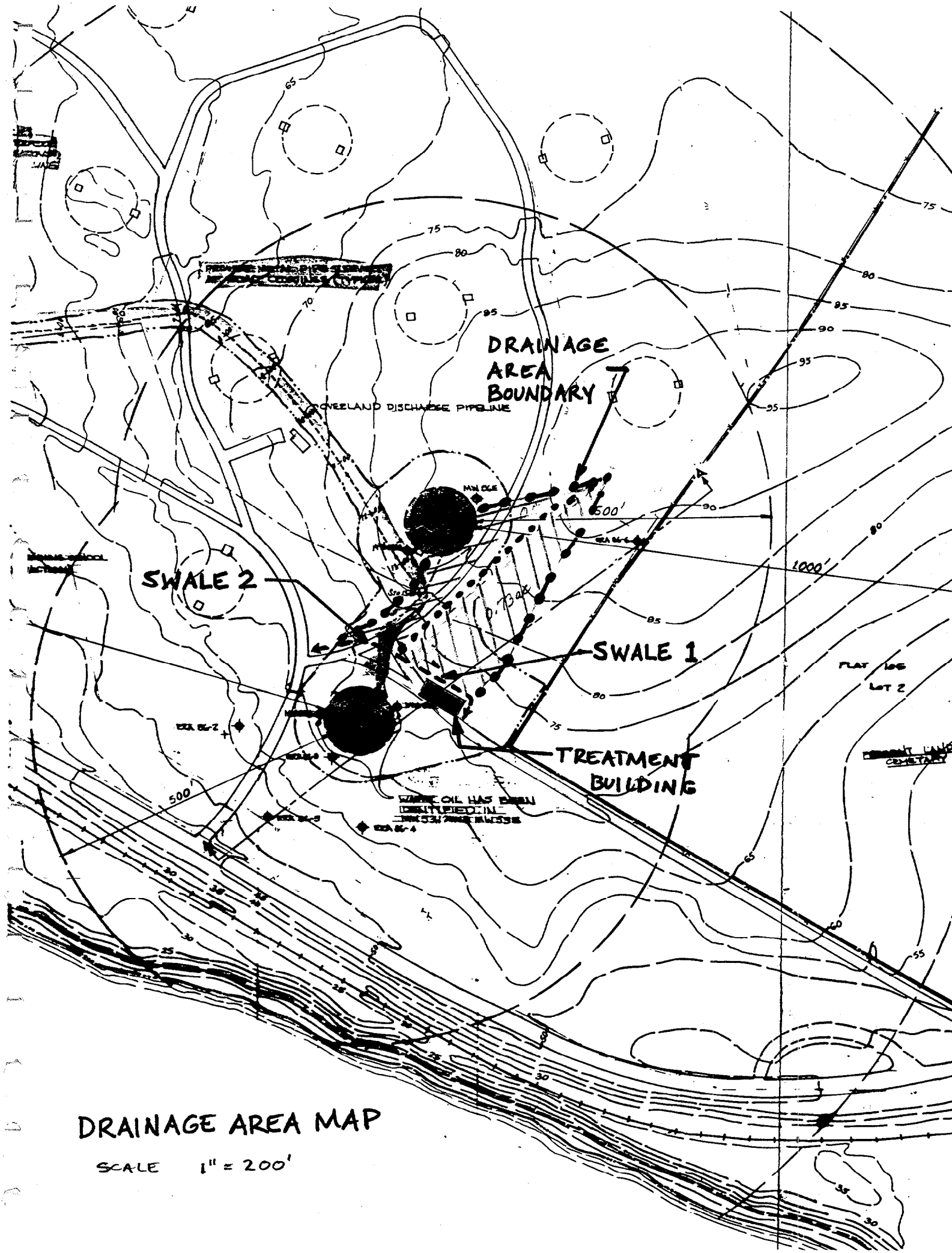
by trial & error find depth of flow = 0.5 ft
velocity = 1.7 fps

For Swale 2 $Slope_{max}$ = 5% = 0.05 Q = 0.7 cfs
grass n = 0.030

find depth of flow = 0.3 ft
velocity = 3.1 fps

Allowable velocity for grass channel = 5 fps ✓
Allowable depth for freeboard = 1.0 ft ✓

As an extra precaution the swale outlets will be protected with a riprap apron

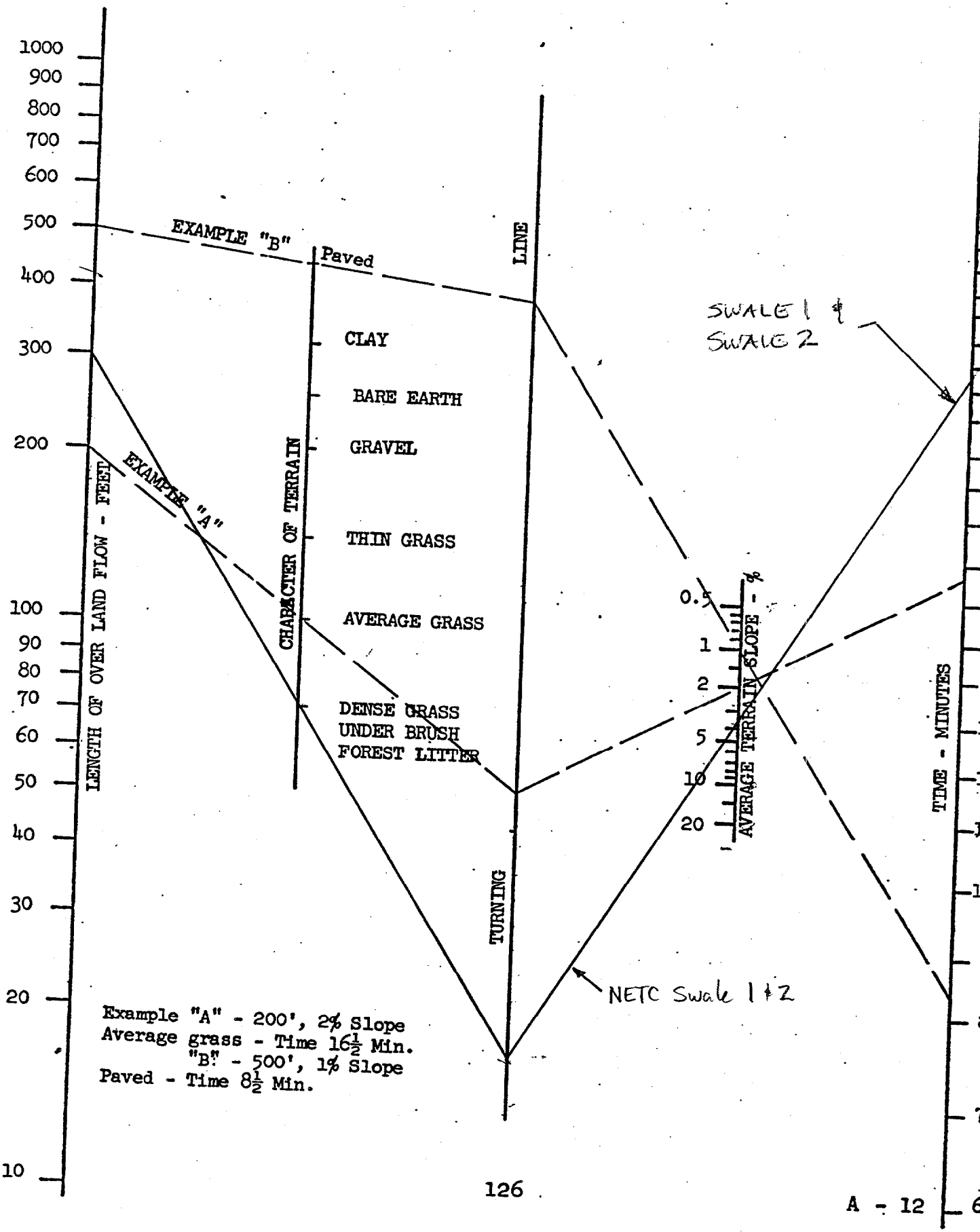


DRAINAGE AREA MAP

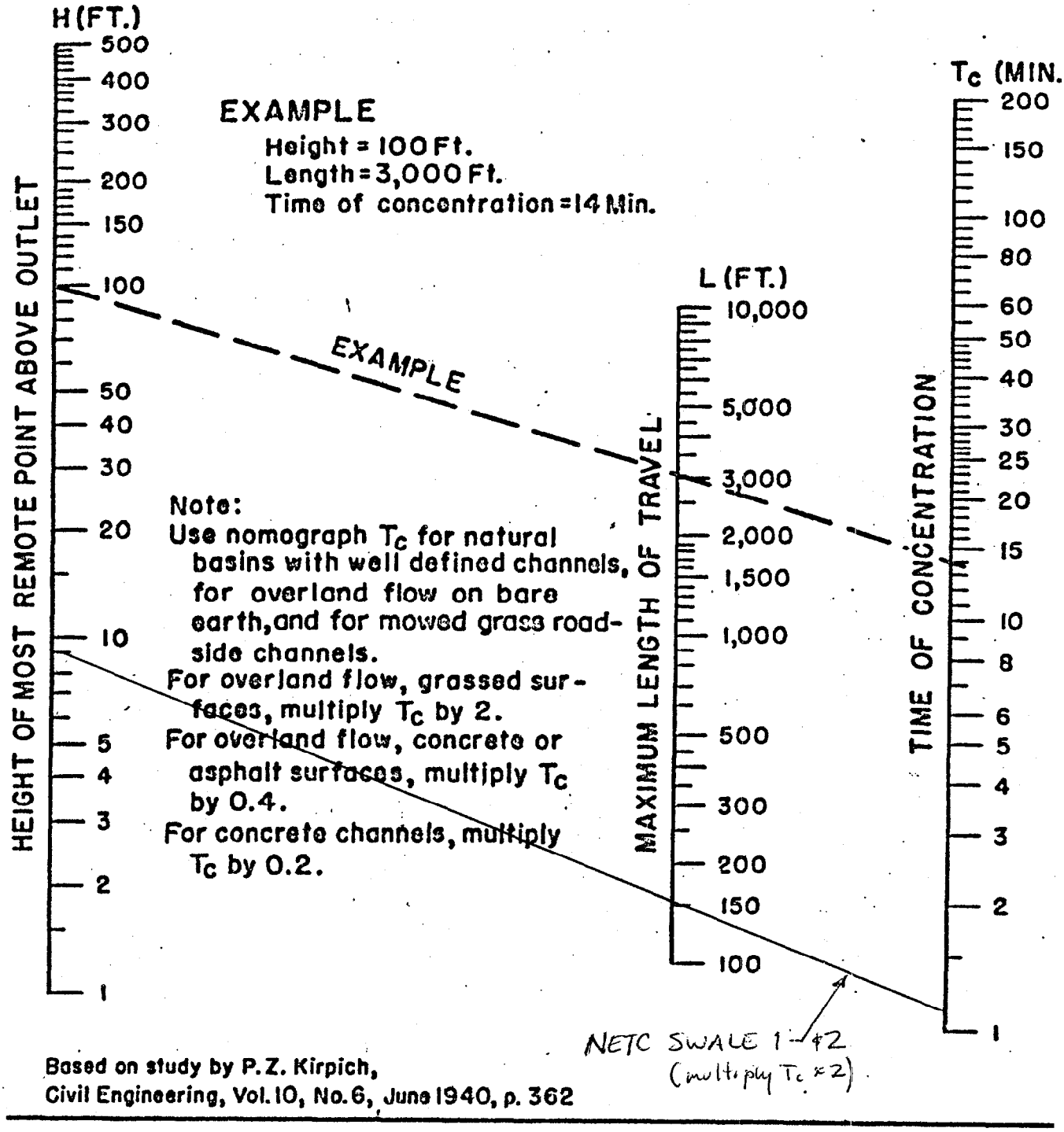
SCALE 1" = 200'

TIME OF CONCENTRATION

(OVERLAND FLOW ONLY)



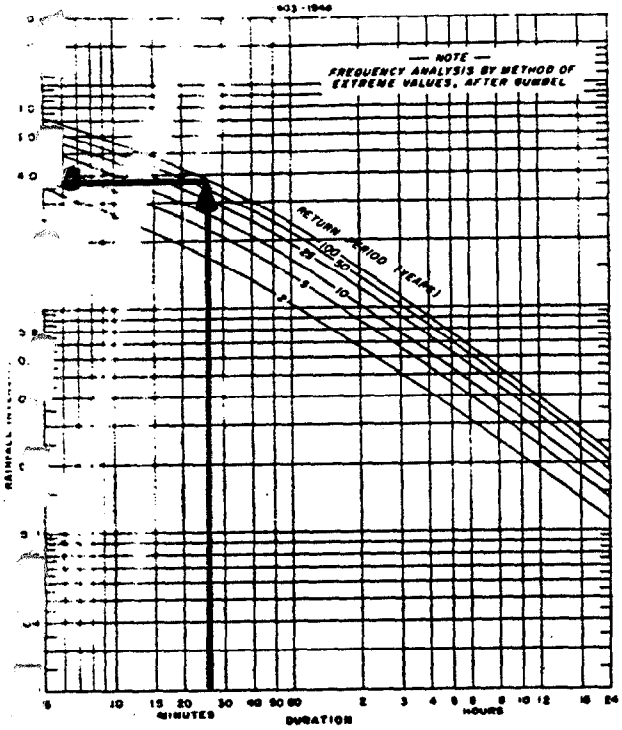
Example "A" - 200', 2% Slope
Average grass - Time 16½ Min.
"B" - 500', 1% Slope
Paved - Time 8½ Min.



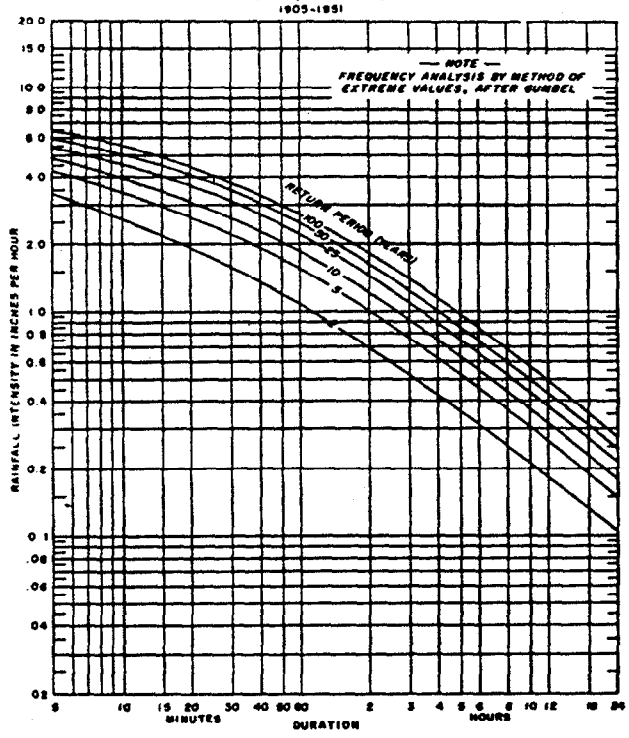
TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

RAINFALL INTENSITY-DURATION-FREQUENCY CURVES

BLOCK ISLAND, RHODE ISLAND
1903-1948

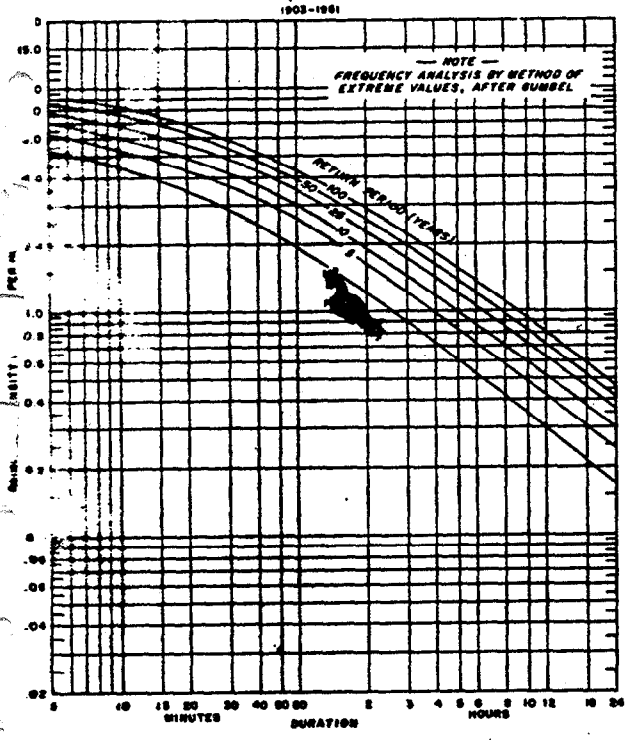


PROVIDENCE, RHODE ISLAND
1905-1951



NETC T_c = 25 min

CHARLESTON, SOUTH CAROLINA
1903-1951



COLUMBIA, SOUTH CAROLINA
1903-1951

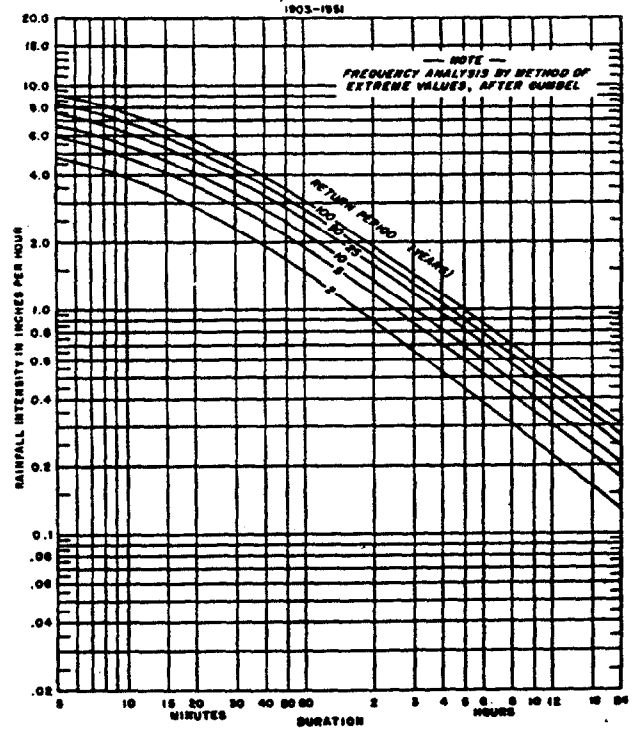


TABLE I-1. RATIONAL RUNOFF COEFFICIENTS

VALUES OF C IN Q = CiA

SOIL TEXTURE

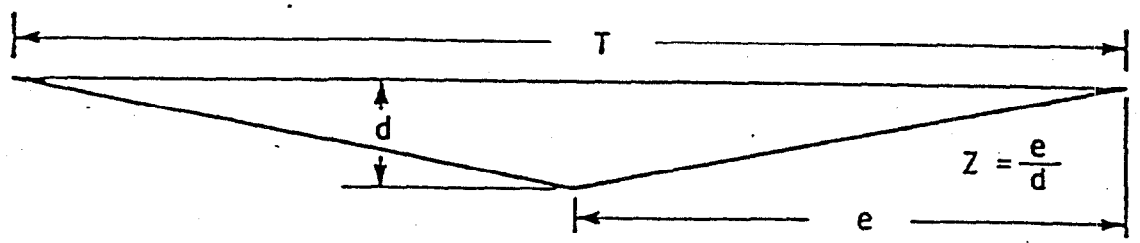
NETC

Topography and Vegetation	Open Sandy Loam	Clay and Silt	Tight Clay
Woodland			
Flat 0-5% slope	0.10	0.30	0.40
Rolling 5-10% slope	0.25	0.35 .425	0.50
Hilly 10-30% slope	0.30	0.50	0.60
Pasture			
Flat	0.10	0.30	0.40
Rolling	0.16	0.36	0.55
Hilly	0.22	0.42	0.60
Cultivated			
Flat	0.30	0.50	0.60
Rolling	0.40	0.60	0.70
Hilly	0.52	0.72	0.32
Urban Areas	30% of area impervious	50% of area impervious	70% of area impervious
Flat	0.40	0.55	0.65
Rolling	0.50	0.65	0.80

(Lit. Cit. No. 6, Schwab, et al).

Figure 8-28 - Channel Geometry

V - Shape

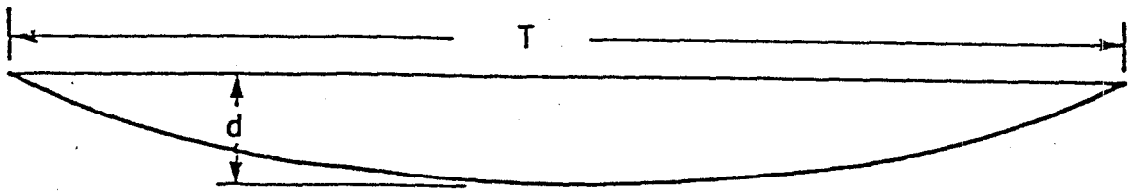


Cross-Sectional Area (A) = Zd^2 =
Top Width (T) = 2dZ

Hydraulic Radius (R) = $\frac{Zd}{2\sqrt{Z^2 + 1}}$

NETC
Z = 4
d_{max} = 1.5'

Parabolic Shape

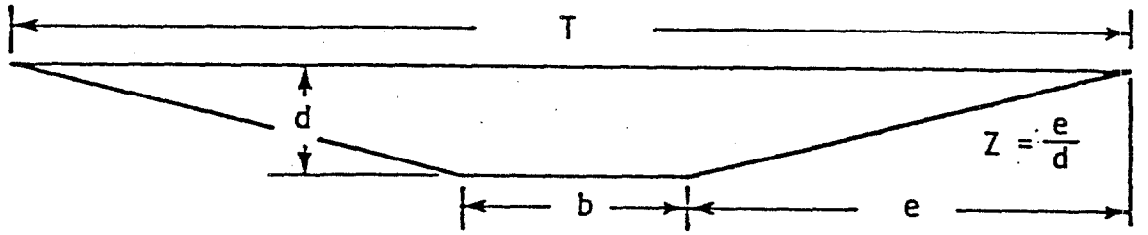


Cross-Sectional Area (A) = $\frac{2}{3}$ Td

Top Width (T) = $\frac{1.5\ A}{d}$

Hydraulic Radius = $\frac{T^2d}{1.5T^2 + 4d^2}$

Trapezoidal Shape



Cross-Sectional Area (A) = $bd + Zd^2$
Top Width (T) = b + 2dZ
Hydraulic Radius = $\frac{bd + Zd^2}{b + 2d\sqrt{Z^2 + 1}}$

Source: U.S. Department of Agriculture, Soil Conservation Service, Storrs, Connecticut.

(Revised 2/14/86)

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SHEET NO. 8 OF 9
PROJECT NO.
DATE 20 JAN 1993
BY R. Nault
CHK'D REV 30 APR 1993

SUBJECT e. Roadways

The parking area and access driveway have been designed with a 3" asphalt concrete wearing surface on a 6" base and 8" subbase to handle the delivery truck projected load consistent with CBR values. The maximum slope is 6% and the minimum horizontal curve is 50 ft radius.

Traffic will only be the result of treatment plant operators and delivery vehicles.

A gravel road will be constructed in the remote areas of the extration well system to facilitate monitoring and maintenance of the wells.

TRC

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SHEET NO. 9 OF 9

PROJECT NO.

DATE 20 JAN 1993

BY R Nauh

CHK'D REI 30 APR 1993

SUBJECT f. Site Improvements

The treatment building area will be protected with a 7 ft high chain link fence (as per Mil Handbook 1005/12). Access will be through double 12 ft wide swing gates at the entrance to the parking area.

Silt fencing will be required on the downgradient side of all fills and limits of grading to reduce sedimentation and erosion during construction.

Turf will be established over all disturbed areas with jute-mesh or filter fabric required in the drainage swales.

3.3 Architectural Design

3.3 Architectural Design

I. Basis of Design

Architectural aspects of the project relate to the planning of a building structure. The Treatment Building will be a pre-engineered building to contain the miscellaneous equipment.

It will be a rigid frame metal-sided, earth-tone painted structure on a concrete slab with an overhead door for equipment access, a service entry door and an emergency exit door. The footprint will be nominally 76 feet long and 32 feet wide yielding a gross area of 2,432 square feet. The inside wall clear height will be 15 feet. The roof will be metal with gutters and downspouts.

The building size was dictated by the equipment space requirements based on commonly available package treatment units with a reserve factor applied.

The building will have a bathroom with a water closet and lavatory and enclosed office/lab area. The building will be insulated (U-Valve = 0.05) and have heating, ventilation, lighting and fire alarms. An aboveground 1,000 gallon heating oil tank with 110% containment dike will be installed outside of the building. Handicapped access is not required per NAVFAC guidance.

II. Calculations

Appropriate calculations are contained elsewhere or are the responsibility of the building supplier.

3.4 Structural Engineering Design

3.4 Structural Engineering Design

I. Basis of Design

Structural engineering design aspects of the project include reinforced concrete and building structure design. A soils investigation has been performed to determine the allowable soil bearing capacity. A data summary from the soils testing is contained in Appendix A. With a rigid frame, pre-engineered building, it is the responsibility of the supplier to provide the design of the building and footings with all load transferred to the columns.

Between the column foundations, a reinforced concrete frost wall foundation will be constructed and a reinforced concrete slab-on-grade floor poured. Concrete slab design under water treatment equipment will be based on actual working loads for the specific equipment. At a minimum, the floor slab will be designed for a load of 500 psf. The structure will be designed for Seismic Zone 2 conditions.

II. Structural Engineering Calculations

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a. Foundation Systems	1
b. Building Structure	2

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INTERIM REMEDIAL ACTION
TANK FARM FIVE
NETC, NEWPORT R.I.
CONTRACT No N62472-92-C-0056

SHEET NO. 1 OF 2
PROJECT NO.
DATE 20 JAN 1993
BY R NAUHT
CHK'D REV 30 APR 1993

SUBJECT a. Foundation Systems

Minimum Standards That Will be Required:

Live Loads

The reinforced concrete slab will be designed for a 500 PSF live load.

Design Method

Concrete Strength (ACI)	F'c = 4,000 psi
Reinforcing Steel	Fy = 60,000 psi
Design Soil Bearing Pressure	2 TONS / SQ. FT.

General Notes

1. Concrete: Normal Weight, Air-entrained

Structure	Max Aggregate Size
Slab	0.75 inch
Footings	1.50 inch

2. Reinforcing Steel

Deformed bars	ASTM A615 GRADE 60
Welded Wire Fabric	ASTM A185

3. Frost Protection

Footings to be min 50" below grade

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PROJECT NO. _____

DATE 20 JAN 1993
BY R. Nault
CHK'D REV 30 APR 1993

SUBJECT b. Building Structure

Building structure to be designed by Professional Engineer for the Preengineerd Metal Building supplier according to the following standards:

Uniform Building Code
State of Rhode Island Building Code
Standard Engineering Practice

LIVE LOAD CRITERIA

Roof (Snow) Load	25 PSF
Wind Design Velocity	114 MPH
Seismic Zone	2

SEE DESIGN DRAWINGS FOR ADDITIONAL CRITERIA

3.5 Mechanical Engineering Design

3.5.1 Heating and Ventilation Design

I. Basis of Design

A heating and ventilating system has been designed for the Treatment Building on a preliminary basis. When the treatment building location and process has been approved and final equipment layout determined, the heating and ventilating system will be finalized.

Oil fired forced hot air has been selected for heating because of the excessive distance (700 feet ±) to connect to the natural gas line at the Firefighting Training Center.

II. Heating and Ventilating Design Calculations

Index

Item	Page
a. Building Heat	1
b. Ventilation	2

* BUILDING HEAT

Roof:
76 x 32 = 2432 sq. ft.

Walls:
((76 x 2) + (32 x 2)(16' avg. hgt.) = 3456 sq. ft.
5888 sq. ft.

Q = A U t
= (5888)(.05)(61) = 17,958 BTH

Infilt.: 2432 sq. ft. x 16' (avg. hgt.) = 38,912 cu. ft.
/60 = 648 CFM

@ 2 A.C. = Q = CFM (1.08)(Δt)
= 648 (1.08)(61)(2)
= 85,380 BTH

Outside Air:
Q = CFM (1.08)(Δt)
= (600)(1.08)(61)
= 39,528 BTH

Floor: 2432 sq. ft. x 2 BTH/sq. ft.
= 4865 BTH
TOTAL = 147,731 BTH

1 Furnace at 250,000 BTH(+) (ALLOWING 100,000 BTH FOR FUTURE BLDG. EXPANSION)

* BASED ON 9°F. OUTDOOR DESIGN & 70 °F. INSIDE DESIGN TEMP. = 61°F. Δt

VENTILATION

76 x 32 = 2432 sq. ft.
x 16' (avg. hgt.) = 38,912 cu. ft.

Summer Vent (15 A.C.):
38,912 x 15 = 583,680 cu. ft./hr
/60 = 9728 CFM
SAY = 9800 CFM

/2 = 4900 CFM/fan

* 2 fans @ 4900 CFM each (EF-1 & EF-2)

Winter Vent (.25 CFM/sq. ft.):
2432 sq. ft. x .25 = 608
SAY 600 CFM
*1 fan @600 CFM (EF-3)

LAB Room:
5 x 9 = 45 sq. ft.
x 16 (avg. hgt.) = 720 cu. ft.

720 cu. ft. (20 A.C.) = 16,200 cu. ft./hr.
/60 = 270 CFM
* 1 fan @ 270 CFM (EF-4)

TOILET ROOM:
5x9 = 45 SQ. FT.
x 16 (AVG. HGT.) = 720 CU. FT.

720 CU. FT. (8 A.C.) = 5,760 CU. FT./HR.
/60 = 96 CFM
SAY 100 CFM

* 1 FAN @ 100 CFM (EF-5)

DUCT SIZING

2000 CFM @ MAX. .10" S.P. /100 = 18x16" (.09)

1300 CFM @ MAX. .10" S.P. /100 = 18x12" (.085)

600 CFM @ MAX. .10" S.P. /100 = 12x10" (.085)

100 CFM @ MAX. .10" S.P. /100 = 8x6" (.05)

3.5.2 Plumbing Design

I. Basis of Design

Plumbing facilities in the Treatment Building are minor in scope to serve sanitary and emergency functions. An enclosed bathroom with a water closet and lavatory will be provided with a wash sink and emergency shower/eye wash station located in the open work area.

Wash hose facilities will be provided around the treatment units for required cleaning and maintenance.

A point of use (on demand) electric water heater will be designed for domestic use. A separate on-demand electric water heater will be required to temper water temperature to the emergency shower/eye wash station.

Water service pipe to the building will be Type K flexible copper sized to yield 35 psi minimum working pressure. Type L copper pipe will be used for water service in the building sized to provide a maximum flow rate of 10 fps.

Waste piping will be schedule 40 DWV PVC pipe with a minimum size of 3" and slope of 1/4 inch per foot. A separate floor drain/spill containment system will be constructed with 4" schedule 40 DWV PVC pipe to a building sump. A manually activated pump will discharge sump water to the inlet of the treatment system.

Roof drainage flow standards will be established and the gutter design will be the responsibility of the pre-engineered metal building supplier's engineer. A minimum gutter width will be specified.

All designs are based on standard professional engineering practice using the following manuals and codes:

Navfac Design Manual DM 3.01 "Plumbing Systems"

National Standard Plumbing Code

II. Plumbing Design Calculations

Index

Item	Page
a. Water System	1
b. Wastewater System	1
c. Roof Drainage	1

TRC
TRC Environmental Corporation

INTERIM REMEDIAL ACTION
TANK FARM FIVE
NETC, NEWPORT, R.I.
CONTRACT No N 62472-92-C-0056

SHEET NO. 1 OF 1
PROJECT NO.
DATE 20 JAN 1993
BY R. NAULT
CHK'D REV 30 APR 1993

SUBJECT a. Water System

The predicted average day water demand for the building is 300 gpd (see Civil Engineering Calculations) The instaneous peak demand is thus determined by the fixture unit method:

Fixture	Demand Weight	Quantity	Total
Water Closet - tank	5	1	5
Lav Sink	2	1	2
Lab Sink	3	1	3
Hose Bib	5	6	30

Total Fixture Units = 40

From NBS graph Water Demand = 25 GPM

With building inlet pressure = 70 psi ± there will not be a low pressure problem.

b. Wastewater System

The treated water effluent and building services water use will be combined in an 8" Ductile Iron Pipe running to a sanitary sewer manhole. The capacity of this pipe according to Manning's equation = 1,500 gpm. This exceeds the predicted flow of 50 gpm + 25 gpm = 75 gpm

c. Roof Drainage

Based on criteria in the Mil Handbook, the roof drain system shall be designed for a rainstorm intensity of 4 inches per hour.

DEMAND WEIGHTS

Table 5 — Suggested allowances for decrease in capacity of ferrous pipes

Estimated load (gpm)	Recommended allowances to be applied to estimated load or to capacity of new ferrous pipe to provide for aging							
	Noncaking		Slightly caking		Caking, moderately bad		Caking, very bad	
	To capacity	To load	To capacity	To load	To capacity	To load	To capacity	To load
	%	%	%	%	%	%	%	%
0.0 to 2.5	−20	+25	−40	+60	−60	+150	−80	+400
2.6 to 5.0	−20	+25	−35	+50	−55	+130	−75	+300
5.1 to 10	−20	+25	−30	+45	−55	+110	−65	+200
11 to 8	−20	+25	−30	+45	−50	+100	−65	+200
19 to 37	−20	+25	−30	+40	−45	+80	−60	+150
38 to 56	−20	+25	−30	+40	−40	+65	−60	+150
57 to 100	−20	+25	−25	+35	−35	+50	−55	+125
111 to 175	−20	+25	−25	+35	−35	+50	−55	+125
176 to 310	−20	+25	−25	+35	−30	+45	−50	+100
311 to 635	−20	+25	−25	+35	−30	+45	−50	+100
636 to 1,150	−20	+25	−25	+35	−30	+45	−50	+100
1,151 to 1,870	−20	+25	−25	+35	−30	+45	−50	+100

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Table 6 — Demand weights of fixtures in fixture units[1]

Fixture of group[2]	Occupancy	Type of supply control	Weight in fixture units[3]
Water closet	Public	Flush valve	10
Do	...do	Flush tank	5
Pedestal urinal	...do	Flush valve	10
Stall or wall urinal	...do	...do	5
Do	...do	Flush tank	3
Lavatory	...do	Faucet	2
Bathtub	...do	...do	4
Shower head	...do	Mixing valve	4
Service sink	Office, etc.	Faucet	3
Kitchen sink	Hotel or restaurant	...do	4
Water closet	Private	Flush valve	6
Do	...do	Flush tank	3
Lavatory	...do	Faucet	1
Bathtub	...do	...do	2
Shower head	...do	Mixing valve	2
Bathroom group	...do	Flush valve for closet	8
Do	...do	Flush tank for closet	6
Separate shower	...do	Mixing valve	2
Kitchen sink	...do	Faucet	2
Laundry trays (1-3)	...do	...do	3
Combination fixture	...do	...do	3

[1]For supply outlets likely to impose continuous demands, estimate continuous supply separately and add to total demand for fixtures.
[2]For fixtures not listed, weights may be assumed by comparing the fixture to a listed one using water in similar quantities and at similar rates.
[3]The given weights are for total demand. For fixtures with both hot- and cold-water supplies, the weights for maximum separate demands may be taken as 3/4 the listed demand for the supply.

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CONTINUED ON ENG INFO — 31

Table 10 — Water-demand estimates for typical buildings

Type of building as to number and kind of fixtures	Bathrooms	Kinds of fixtures: Kitchen sinks or combination fixtures	Kinds of fixtures: Groups of 1 to 3 laundry trays	Total fixture units[1]: With flush valves for water closets	Total fixture units[1]: With flush tanks for water closets	Total demand[2]: With flush valves for water closets	Total demand[2]: With flush tanks for water closets
	Number	Number	Number	Number	Number	gpm	gpm
A.....	1	1	0	10	8	27	6
B.....	1	1	1	13	11	30	8
C.....	2	1	1	21	17	36	12
D.....	3	2	1	31	25	42	17
E.....	4	4	2	46	38	49	24
F.....	8	8	3	89	73	64	36
G.....	16	16	4	172	140	84	52

[1]Total fixture units from Table 6.
[2]Total demand from Figure 8.

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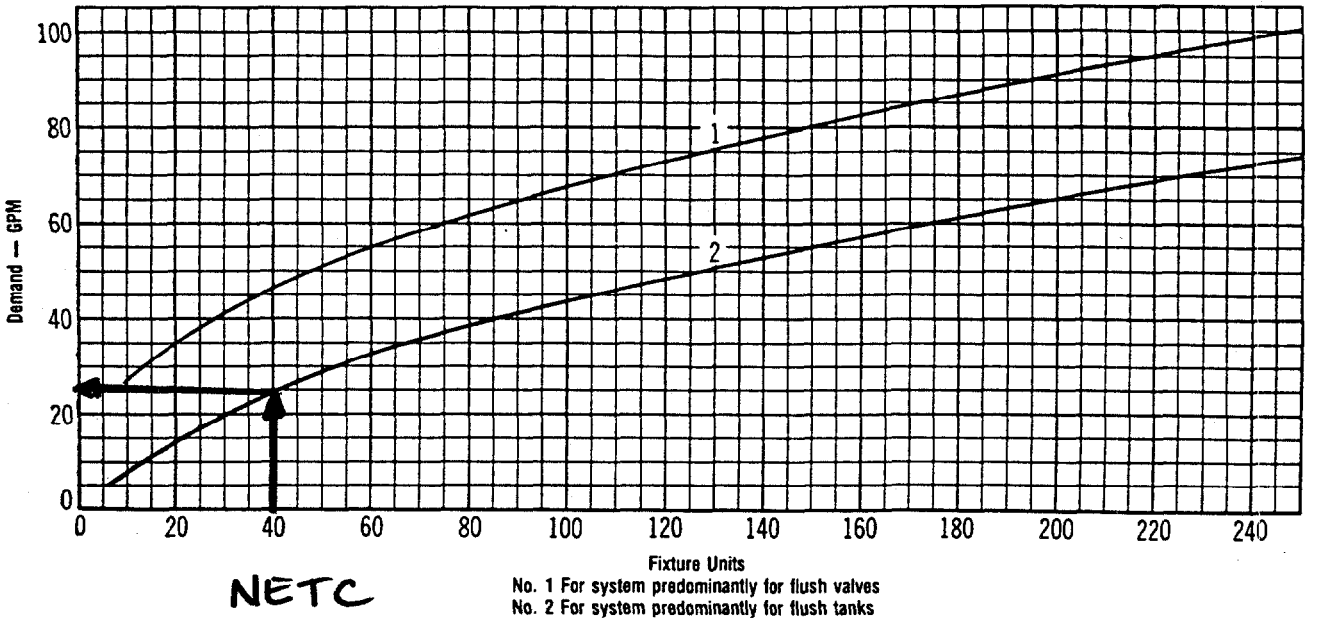
Figure 8 — Chart of demand weights in fixture units



NETC

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CONTINUED ON ENG INFO — 32

3.5.3 Ground Water Treatment Process Design

I. Basis of Design

Per the Record of Decision, the selected Interim Remedial Action for ground water treatment includes: the removal of dissolved metals using a coagulation/filtration process to meet discharge standards and so that metals do not interfere with subsequent treatment; the removal of volatile organic compounds using a ultraviolet light oxidation system (with polishing using a granular activated carbon adsorption media); and, the discharge of treated water to the Newport POTW via the NETC sanitary sewer system.

The major components of the treatment system have been selected. Final refinement of such aspects as chemical feed rates, UV/oxidation residence time, etc. will be based on bench scale or jar tests to be conducted of the contaminated ground water plume. Valves, sensors, instrumentation and controls are described below and have been shown on Drawings M4 and M5. The predicted maximum ground water extraction flow rate is 25± gallons per minute (gpm) and the treatment system capacity is 50 gpm. This treatment system may be utilized to remediate ground water from other areas of the tank farms in the future.

Designs are based on standard professional engineering practice and criteria from the Navy Design Manuals and Handbooks, American Society of Civil Engineers, Water Environment Federation, the New England Interstate Water Pollution Control Commission (NEIWPCC), etc. The following references have been used for design:

- Navy MH 1005/9, Industrial and Oily Wastewater Control, ©1988
- Water Treatment Principles & Design, ©1985, J.M. Montgomery Consulting Engineers, Inc.
- Guides for the Design of Wastewater Treatment Works, ©1980, NEIWPCC
- American Water Works Association Standards

IA. Treatment Process and Controls Description

1. General

Due to the variability in the ground water extraction well yield as influent to the treatment system, the main process line pump system has been designed for duplex service. With this flexibility, if the total well yield is less than the treatment system design capacity of 50 gpm, one pump may be taken out of service and a lower but steady flow maintained through the process. This is the preferred alternative to cycling the treatment system by batching 50 gpm when the equalization tank fills. In all cases, level controls can automatically activate the second pump to duty based on rising water levels in any of the tanks. The entire system will be integrated with a programmable logic controller (PLC) to sense and operate individual unit processes as well as interlock all units if a failure condition is detected to shutdown all systems.

2. Main Line Process

a. Ground Water Extraction

Ground water will be pumped from wells designed to provide complete capture of the plume. A low level sensor in the wells will turn off the submersible pumps if excessive drawdown occurs to protect against motor burnout. A high level sensor will restart the pump upon recovery. A minimum drawdown in the wells will be established with the sensors so that a gradient exists towards the wells even when the pumps are off to ensure capture.

Extracted ground water will enter the treatment system in an equalization tank (Tank #1) acting to dampen flow surges and prime the transfer pump system. In the tank a probe will measure pH and adjust the caustic feed rate to produce a pH of ±8.5. In the tank feed line a flow indicator (FI) will only allow caustic to be fed in the line when water flow is detected. A mixer

in the equalization tank will be operated on a timed control. At the higher pH the solubility of the metal ions is decreased and precipitates will start to form.

b. Flocculator/Clarifier

As the water level in the equalization tank rises, a pressure transducer will activate one of the transfer pumps (P-01A) to initiate flow to the flocculator/clarifier (F/C). In the pump discharge line a flow meter (FM) will sense and measure flow to pace the coagulant, flocculant and oxidant chemical feed pumps for injection into this line. If the water level keeps rising in the equalization tank, the transducer/PLC will activate the second transfer pump (P-01B). If the water level rises further to an unsafe level, the transducer/PLC will shutdown all upstream feed sources (in this case the only upstream feed source is the extraction wells) and activate an alarm in the building and to the Naval Base Fire/Emergency Station. This control logic is repeated in all tank/pump units in the system.

Flow will enter the rapid mixing and flocculation basins of the F/C where mechanical mixers activated by the flow meter provide turbulent and laminar agitation, respectively. The cationic coagulant enhances the formation of the precipitates into particles and the anionic flocculant promotes agglomeration of particles into a larger, settleable mass. The oxidant serves to break down any chelated metals complexed with organics that would otherwise be difficult to settle. The feed rates of all chemicals will be optimized during system start-up based on jar and on-line tests. In the clarifier, flow is directed up through the inclined settling plates to overflow weirs. Solids settle to the hopper bottom for blowoff. Clarified water will overflow to a clearwell (Tank #2). A 90% removal efficiency of Total Suspended Solids can be expected in the F/C to a level of 10 mg/l.

c. Pressure Filtration

When the water level rises in the clearwell, a transducer/PLC will activate the transfer pump system (P-02A/B) to charge the water to 25 psi± necessary for the pressure filters. Flow is forced through the dual media (antracite/sand) filters where further solids removal occurs by retaining particles in the pore spaces of the media. Under clean conditions the headloss through the units will be ±4 psi. As solids clog the media, the headloss will increase. The plant operator will manually initiate the backwashing of one filter unit at a time when the headloss approaches ±12 psi. It is expected that with proper operation of the clarifier, the filters will not clog rapidly thus enabling the operator to backwash one unit per day as a good housekeeping practice before they reach the 12 psi headloss while keeping the other unit on-line. If the headloss builds unchecked to the point that the pumps cannot overcome the head required, a pressure switch will activate the shutdown/alarm control. Effluent from the pressure filters should have a Total Suspended Solids concentration below 2 mg/l.

From the pressure filter flow will enter a clearwell (Tank #3) which in addition to priming the next set of transfer pumps will also be used to store water for filter backwashing. Under normal system operation only the top 500 gallons in the tank will be used for the downstream transfer pumps (P-03A/B) as controlled by the transducer/PLC. For backwash water 1500 gallons will remain in the tank for prime on the backwash pump (P-04). In this tank a probe will measure pH and adjust the acid feed rate to produce a pH of ±5.7 using similar controls as discussed earlier for the caustic feed system. This lower pH is required for the UV/oxidation treatment because of possible fouling problems from the carbonate hardness at the higher pH. The tank will be equipped with a mixer operated by an adjustable timer.

d. UV/Oxidation Chamber

The transfer pumps (P-03A/B) will energize the water to a discharge pressure of 15 psi required to move water through the remaining treatment units. A pressure switch on the pump discharge line will sense high backpressure indicating a blockage and initiate the shutdown/alarm sequence. In the UV/Oxidation Chamber, hydrogen peroxide is added as an oxidant and the volatile organic compounds (VOC) in the water are attacked and converted to carbon dioxide, water and inorganic ions. A VOC removal efficiency of 80% can be expected.

e. Granular Activated Carbon Adsorption

Flow then will enter the granular activated carbon filters where remaining organic concentrations are reduced through adsorption to the media. The carbon usage rate should be low because most organics will be removed in the UV/Oxidation Chamber. The effluent will be monitored to determine when breakthrough is approaching.

The treated water will then flow by gravity to the sanitary sewer system for discharge.

3. Off-Line Processes

a. Filter Backwash

The operator will manually operate the valve to initiate backwashing. The backwash pump (P-04) will force water at a high flow rate upwards through the filter to remove solids. The backwash water will enter the Sludge Thickener Tank (Tank #5) to remove solids from the system. Water will be continuously decanted off the top of the tank to the Recycle Tank (Tank #6) while sludge settles to the cone-shaped bottom. High level in this tank as sensed by a float will shutdown any tank feed sources and activate the alarm condition.

b. Clarifier Sludge Blow-Off

Sludge accumulated in the bottom of the clarifier will be intermittently withdrawn by the use of a sludge pump (SP-01) controlled with an adjustable timer. The sludge will enter the Sludge Thickener Tank (Tank #5) at a solids concentration of 1-2%. Water will be continuously decanted from the tank as discussed above. When the Recycle Tank fills, a transducer/PLC will activate a pump to return this water to the head of the treatment plant (Tank #1).

c. Filter Press Operation

As the sludge level builds in the thickener tank (Tank #5), the plant operator will have to manually initiate the filter press operation. Sludge will be withdrawn from Tank #5 using an air diaphragm sludge pump (SP-02) at a solids concentration of 3%± to be dewatered to a cake form with a solids concentration of 30%± for disposal. In the plate and frame type filter press, the system is energized to 100 psi and liquid filtrate is removed from the sludge. The filtrate will flow by gravity to the Recycle Tank (Tank #6) for return to the system. The filter press will be elevated to facilitate this arrangement. The recycle tank will be maintained normally empty (a maximum of 200 gallons to prime the recycle pump (P-05) for this purpose and to ready the process for storage of the 1500 gallon± slug of water resulting from filter backwash. The elevated filter press will also allow the cake to be dropped from the press into drums for storage.

d. Plant Floor Drain System

The building floor slab will be sloped to floor drains which will be piped to a closed sump and pump system. Under normal operation, the floor drains will collect plant washdown water and the pump can discharge these flows to the head of the system (Tank #1). To protect against a chemical spill upsetting this operation, the sump pump (VP-01) will only be activated by the

operator manually turning the pump on. A float control set at a sump volume of 200 gallons will trip a building alarm telling the operator the sump is filling. The operator can then decide to turn the pump on to discharge the water to Tank #1 or initiate spill containment measures in the sump. If the liquid level continues for rise further, a level control will trip a second alarm to the Naval Base Fire/Emergency Station and shutdown all systems.

e. Treatment System Maintenance Features

Each treatment unit will be equipped with bypass piping to take that system out of service while possibly maintaining plant flow. This operation should only be allowed in an emergency and if the effluent will still meet discharge requirements. The piping system will be installed with line drains/sample taps (L.D.) that will enable equipment and tanks to be drained if necessary. These line drains will be equipped with quick-connect end fittings to allow connection of a portable hose that could be routed to the floor drain or some other removal option.

II. Ground Water Treatment Process Design Calculations

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TRC
TRC Environmental Corporation

INTERIM REMEDIAL ACTION
TANK FARM FIVE
NETC, NEWPORT R.I.
CONTRACT No. 62472-92-C-0056

SHEET NO. 1 OF 11
PROJECT NO.
DATE 20 JAN 1993
BY R Nault
CHK'D REV 4 MAY 1993

SUBJECT a. Inorganics Treatment

Flow from the extraction wells will enter an equalization tank in the Treatment Building. Caustic chemical (probably Sodium Hydroxide, NaOH) will be added in the water stream prior to the tank to raise the pH to 8.5 ±

The equalization tank is designed to have a minimum residence time, Θ = 30 min. The required volume is then:

$$Vol = Q \times \Theta = 50\,gpm \times 30\,min = 1500\,gal$$

A tank of 2000 gal has been selected. Level sensors in the tank will activate a transfer pump that will lift the process water to the inlet of the flocculator/clarifier. In this line polymers and an oxidizing agent will be added as necessary to facilitate precipitation of metals as hydroxides. The duplex transfer pumps will be sized to pump 1.2 times the expected flow or (1.2 × 50 gpm) or 30 gpm each. The pumping head is the result of static lift requirements and pipe line friction losses. In the 2" pipe the equivalent length is 150 feet resulting in a dynamic head loss = 8 ft. The static head = 12 ft producing a TDH = 20 ft

The pump horsepower can be estimated (assuming pump efficiency = 55%, motor efficiency = 85%)

$$HP = \frac{Q \times H}{3960 \times e_p \times e_m} \simeq \frac{30\,gpm \times 20'}{3960 \times 0.55 \times 0.85} = 0.33$$

Duplex 0.5 horsepower pumps should be used. Flow will be throttled to 50 gpm and the pipe size = 2"

SUBJECT a. Inorganics Treatment

In the flocculator the chemicals are mixed with the ground water and precipitates begin to form. Flow then moves up through the clarifier to the overflow weirs. Settleable solids fall and are collected on the clarifier bottom until they are pumped to a sludge holding tank. The clarifier is typically sized for a capacity of 0.65 gpm/ft² thereby requiring an upflow clarifier with an area of 77 ft².

The flow will then enter a clearwell storage tank of 500 gallons used to prime the transfer pump necessary to raise the water pressure to 25 psi for the pressure filters. The transfer pumps will be designed for 30 gpm as before but the TDH = 85 '±
The pump horsepower required:

$$HP = \frac{30\ gpm \times 85}{3960 \times 0.55 \times 0.85} = 1.4$$

Duplex 1.5 horsepower pumps should be used

The pressure filters are designed for a normal filter rate of 2.5 gpm/ft². The filter area required is then:

$$\frac{50\ gpm}{2.5\ gpm/ft^2} = 20\ ft^2$$

Duplex 3.5 ft ϕ filters will be used so that all flow can be run through one filter when the other requires backwashing. When the headloss through the filter increases to 12 psi ± above

normal, water at a high rate is forced up through the filter in reverse flow to remove any solids from the filter bed and flush the system. Typical backwash rates range from 10 - 20 gpm/ft² for a duration of 10 min. Using an average, the backwash pump rate and sludge thickener storage tank are (for one filter):

$$\text{Backwash Rate} = 15 \frac{\text{gpm}}{\text{ft}^2} \times 10 \text{ ft}^2 = 150 \text{ gpm}$$

$$\text{Tank Vol} = 150 \text{ gpm} \times 10 \text{ min} = 1500 \text{ gal.}$$

Backwash Pump size

$$HP = \frac{150 \text{ gpm} \times 60'}{3960 \times 0.55 \times 0.85} = 4.9 \approx 5.0 \text{ HP}$$

The backwash water will be recycled to the sludge tank to remove solids. Water leaving the filters will flow into a storage tank required to supply the water to backwash with (Tank reserve volume = 1500 gal). The total tank volume will be 2000 gal. to also prime a transfer pump required to raise the hydraulic grade sufficiently for the organics treatment system. Flow entering the UV Oxidation chamber cannot exceed 15 psi. The duplex transfer pumps sizes are then:

$$HP = \frac{30 \text{ gpm} \times 55'}{3960 \times 0.55 \times 0.85} = 0.9 \text{ HP} \approx 1.0 \text{ HP}$$

SUBJECT a. Inorganics Treatment

Off-Line Equipment

Sludge generated during the treatment process will be collected in the clarifier. A sludge pump will carry sludge from the clarifier to a sludge storage tank. From the sludge storage tank liquids and solids will be batched to a filter press to dewater and reduce the volume to be disposed of. The sludge storage tank has been sized so that the filter press has to be run two times per day. The sludge leaving the clarifier is only 1-2% solids. Based on a total removal loading of 300 ppm (200 ppm Suspend Solids and 100 ppm metals), the predicted sludge generation rate is:

$$300 \text{ ppm} \times \frac{1 \text{ lb/gal}}{120{,}000 \text{ ppm}} \times 50 \frac{\text{gal}}{\text{min}} \times \frac{1440 \text{ min}}{\text{day}} = 180 \frac{\text{lb}}{\text{day}} \text{ dry weight}$$

The sludge from the clarifier at 2% solids will have a volume of: $180 \frac{\text{lb}}{\text{day}} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ l}}{20 \text{ g}} \times \frac{1 \text{ gal}}{3.785 \text{ l}} = 1{,}080 \text{ gal/day}$

The filter cake volume after pressing to 30% solids would be: $180 \frac{\text{lb}}{\text{day}} \times \frac{1}{0.30} \times \frac{1 \text{ ft}^3}{30 \text{ lb}} = 7.5 \text{ ft}^3/\text{day}$

A filter press of 4 ft^3 has been selected requiring two press runs per day at maximum flow and loading. This would fill one 55 gallon drum per day for disposal. (Note that the above analysis is based on the high suspended solids results from previous monitoring. Proper well installation and development may reduce the suspended solids loading which could significantly reduce sludge generation)

Off - Line Equipment

The sludge thickener tank will also receive flow from the clarifier bottom blow-off sludge pump operated on a timer basis. The operation will be adjusted to actual field conditions but will be designed to handle 25 gpm with a specific gravity of 1.1. The pump size is then:

$$HP = \frac{25\ gpm \times 30' \times 1.1}{3960 \times 0.55 \times 0.85} = 0.44 \simeq 0.5\ HP$$

The sludge thickener tank will have a continuos decant off the top but has been sized to handle the backwash slug of water plus the clarifier blow-off yielding a tank size of 2000 gallons for filter press storage. The recycle tank will be maintained near empty with only 200 gallons to prime the recycle pump. The tank volume will be 1500 gallons for storage of the backwash slug of water. The recycle pump will be designed for 25 gpm and the size is then:

$$HP = \frac{25\ gpm \times 30'}{3960 \times 0.55 \times 0.85} = 0.41 \simeq 0.5\ HP$$

The air diaphragm sludge pump for the filter press will pump 20 gpm at a pressure of 100 psi requiring 15 SCFM of compressed air.

The building sump will pump 20 gpm and the size is:

$$HP = \frac{20\ gpm \times 20'}{3960 \times 0.55 \times 0.85} = 0.22 = 0.25\ HP$$

TRC
TRC Environmental Corporation

SUBJECT a. Inorganics Treatment

Chemical Feed Systems

Caustic (Sodium Hydroxide) will be added neat at 50% concentration liquid form to raise the pH in response to the probe in the equalization tank. The caustic feed system will be provided with a pump capacity of 2.5 gallons per hour (gph) to be injected with a quill in the tank feed line.

The cationic coagulant, anionic flocculant and hydrogen peroxide as an oxidant will be paced into the pump discharge line feeding the flocculator/clarifier. The coagulant and flocculant come as a liquid or emulsion and must be made down to 1:100 dilution. The maximum concentration expected is 5 mg/l. The feed rate is then:

$$\frac{72{,}000 \text{ gal/day} \times 5 \text{ ppm}}{1{,}000{,}000} = 0.36 \text{ gal/day} \quad \text{neat polymer}$$

$$\text{The diluted feed rate} = \frac{0.36 \text{ gal/day} \times 100}{24 \text{ hr/day}} = 1.5 \text{ gph}$$

The systems will be provided with a pump capacity of 2.5 gph

Sulfuric acid will be added neat at 66° Baume (93% concentration) to lower the pH in response to the probe in the clear well tank. The acid feed system will be provided with a pump capacity of 2.5 gallons per hour to be injected with a quill in the tank feed line.

Hydrogen peroxide feed for the UV/oxidation system is expected at a rate of 6-10 gpd to be injected as part of the oxidation process.

SUBJECT b. Organics Treatment

Flow from the pressure filters will enter the UV/oxidation chamber. An oxidizing agent is added (typically hydrogen peroxide, H_2O_2) and hydroxyl radicals are formed to treat the organic contaminants under high intensity UV light. Organic destruction is primarily a function of the individual chemical bonding structure, hydraulic residence time and light intensity. Discussion with vendors indicated that a 30 kilowatt ± unit would be required with a residence time of 1 minute ±. This will be optomized with a bench scale treatability test.

The rate of UV/oxidation differs with individual organics as discussed earlier. Instead of overdesigning the UV system for one or two contaminants requiring a longer residence time or increased light intensity, a carbon absorption system will be used as a polishing step. Typically, a granular activated carbon tank is sized for a loading rate of 2.5 gpm/ft² and a contact time of 7.5 min. This requires an area of:

$$GAC = \frac{50\ gpm}{2.5\ gpm/ft^2} = 20\ ft^2$$

A single 5' ϕ x 7' high unit has been selected. As the system nears breakthrough as evidenced by monitoring, an exchange unit can be ordered. Upon delivery, the units are equipped with quick-connect fittings for fast change-out and little down time.

TRC

TRC Environmental Corporation

SHEET NO. 8 OF 11

PROJECT NO.

DATE 21 JAN 1993

BY R Nault

CHK'D REV 4 MAY 1993

SUBJECT b. Organics Treatment

The rate of carbon useage varies with the individual contaminant, but is expected to be low in this application. The UV/oxidation process will destroy most of the organic loading with GAC acting as a factor of safety.

C. TREATMENT SYSTEM DESIGN REVIEW

1. DESIGN FLOW:

MINIMUM - 15 GPM
MAXIMUM - 50 GPM

2. HYDRAULIC PROFILE:

FLOW THROUGH THE SYSTEM WILL BE BY GRAVITY AND PUMPING AS SHOWN ON THE HYDRAULIC PROFILE

3. UNIT PROCESS DESIGN STANDARDS

A. FLOCCULATOR / CLARIFIER

SURFACE OVERFLOW RATE -	0.65 GPM / SQ. FT.
INCLINED PLATE ANGLE	55-60°
RAPID MIX BASIN ⊖	2 MIN
FLOC BASIN ⊖	5 MIN

B. PRESSURE FILTERS

FILTRATION AREA - TOTAL	20 SQ. FT.
FILTRATION RATE - NORMAL	2.5 GPM/SQ. FT
FILTRATION RATE (ONE UNIT OUT OF SERVICE)	5.0 GPM/SQ. FT.
BACKWASH RATE	15 GPM/SQ. FT
BACKWASH DURATION	10 MIN
ANTHRACITE THICKNESS/EFF. SIZE	16" / 0.9 mm
SAND THICKNESS/EFF. SIZE	16" / 0.45 mm

TRC
TRC Environmental Corporation

PROJECT NO. _____

DATE 3 MAY 1993

BY R Nault

CHK'D _____

SUBJECT _____

C. UV/OXIDATION SYSTEM

ULTRAVIOLET LIGHT ENERGY	30 kW
DETENTION TIME, ~~Θ~~	1 MIN ±
OXIDANT SOURCE	H_2O_2

D. CARBON ADSORPTION SYSTEM

LOADING RATE	2.5 GPM/SQ. FT.
CARBON STORAGE	2000 LBS.
MIN. CONTACT TIME	7.5 MIN

E. FILTER PRESS

FEED RATE	20 GPM
VOLUME	4 CU. FT.
MAX. PRESSURE	100 P.S.I.

F. MISCELLANEOUS EQUIPMENT

PUMP ARRANGEMENT	DUPLEX
TRANSFER PUMP CAPACITY	60 GPM
MAX PIPE LINE VELOCITY	5 F.P.S.
EQUALIZATION TANK, ~~Θ~~	40 MIN
AIR COMPRESSOR CAPACITY	25 SCFM

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SUBJECT

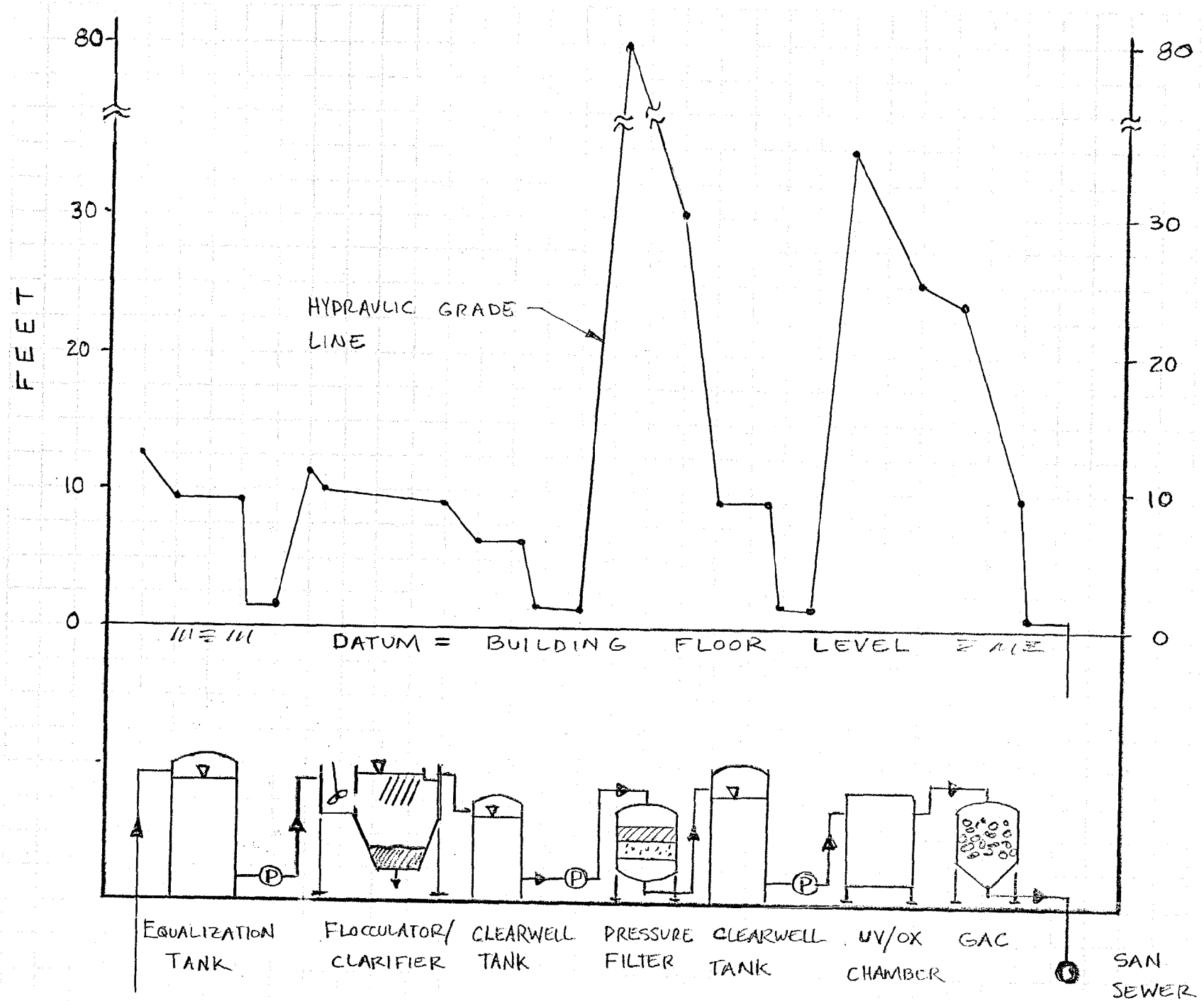
SHEET NO. 11 OF 11

PROJECT NO.

DATE 3 MAY 1993

BY R Nault

CHK'D



HYDRAULIC PROFILE

BULLETIN 850B

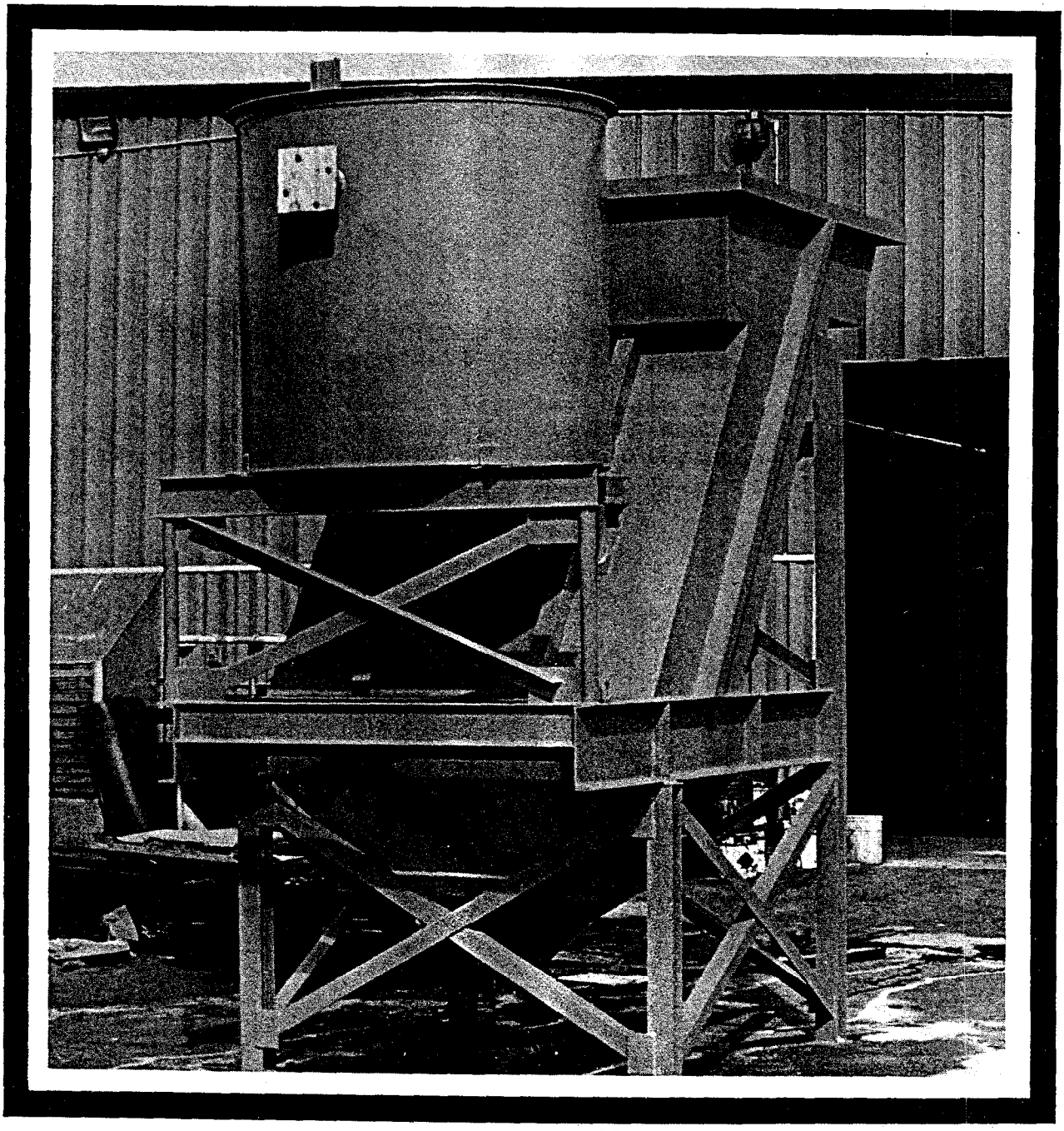
TYPICAL

FLOCCULATOR/CLARIFI

GRAVER WATER

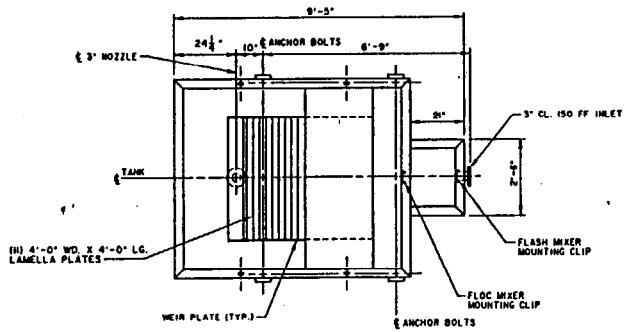
Division of The Graver Company

Lamella Clarifier/Separator

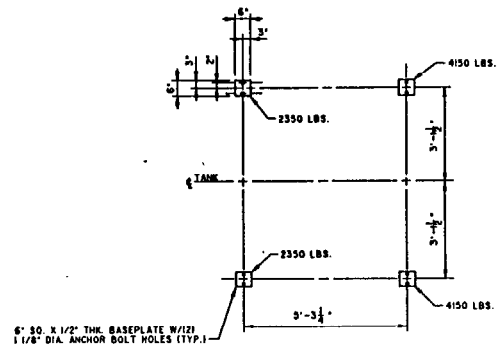


NEW ENGLAND SALES, INC.
Process Equipment & Supplies
740 Corporate Park Pembroke, MA 02359
(617) 826-8855 FAX (617) 826-2390

TYPICAL FLOCCULATOR/CLARIFIER



PLAN

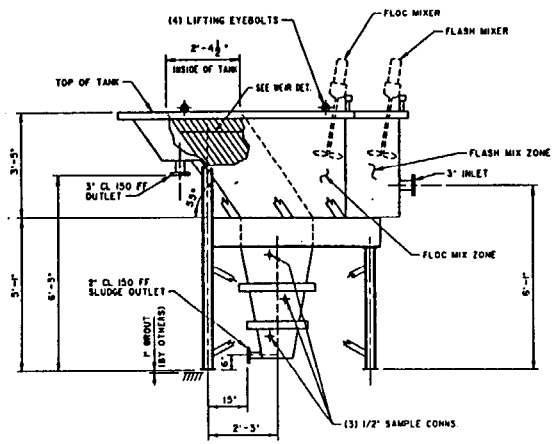


FOUNDATION DETAIL

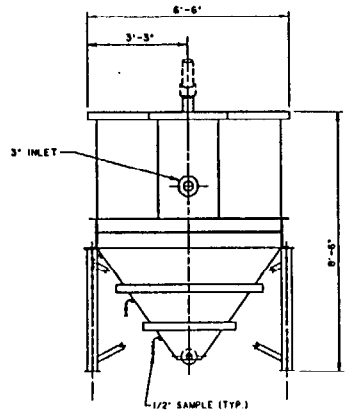
NOTES:
1. ALL FLANGES TO BE STEEL, FLAT FACE, SLIP-ON WITH CL 150 DRILLING STRADDLING VERTICAL AND HORIZONTAL CENTERLINES. COMMERICAL FLANGES SHALL BE USED FOR SIZES UPTO AND INCLUDING 8". LARGER SIZES MAY BE FABRICATED FROM PLATE PER AWWA 207, TABLE I, CLASS D.
2. CLEARANCE OF 4'-0" REQUIRED ABOVE TOP OF TANK FOR REMOVAL OF LAMELLA PLATES. LAMELLA PLATES ARE SHIPPED LOOSE FOR FIELD LOADING INTO THE TOP OF THE TANK.
3. GRAVER ASSUMES NO RESPONSIBILITY FOR CONCRETE DESIGN.
4. LAMELLA SEPARATOR WILL BE SHIPPED IN ONE PIECE AND LAMELLA PLATES SHIPPED LOOSE FOR FIELD INSTALLATION.
5. CUSTOMER TO MAKE PROVISION FOR ACCESS TO TOP OF TANK FOR LAMELLA PLATE REMOVAL. PROPER SAFETY PROCEDURES TO BE USED DURING INSTALLATION OR REMOVAL OF PLATES.
6. CUSTOMER TO ADJUST ELEVATION OF WEIR TO GIVE 4-1/2" FREEBOARD AS SHOWN IN WEIR DETAIL.
7. DUE TO NORMAL FABRICATION TOLERANCE, CUSTOMER TO MAKE PROVISION IN HIS PIPING FOR FIELD FIT-UP.
8. ALL VESSEL INTERIOR OR WETTED CARBON STEEL SURFACES WILL BE CLEANED AND PAINTED PER JOB BILL OF MATERIAL.
9. ALL VESSEL EXTERIOR CARBON STEEL SURFACES WILL BE CLEANED AND PAINTED PER JOB BILL OF MATERIAL.
10. LAMELLA PLATES ARE MADE OF FLAMMABLE MATERIAL AND THUS, WHEN THEY ARE NOT IMMERSED, CARE SHOULD BE TAKEN AGAINST ACCIDENTAL IGNITION. SEE OPERATING INSTRUCTIONS.
11. VERTICAL DIMENSIONS ARE REFERENCED FROM THE "COMMON BASE LINE", BOTTOM OF STEEL (B.O.S).

DESIGN DATA:

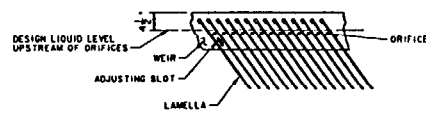
EFFECTIVE PROJECTED PLATE AREA:	94.2 FT²
LAMELLA SPACING:	2"
SHIPPING WEIGHT LAMELLA:	3,600 LBS.
FLOODED WEIGHT LAMELLA:	13,000 LBS.
DESIGN FLOW:	33 GPM
MINIMUM FLOW:	16 GPM
FLASH VOLUME:	70 GALS.
FLOC VOLUME:	235 GALS.



ELEVATION



END ELEVATION



WEIR DETAIL
NO SCALE

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CERTIFIED		

ASSEMBLY
LAMELLA SEPARATOR
MODEL 10612RLF

GRAVER WATER
Division of The Graver Company
A member of The Marmon Group of companies

T- 45745XL REV. A

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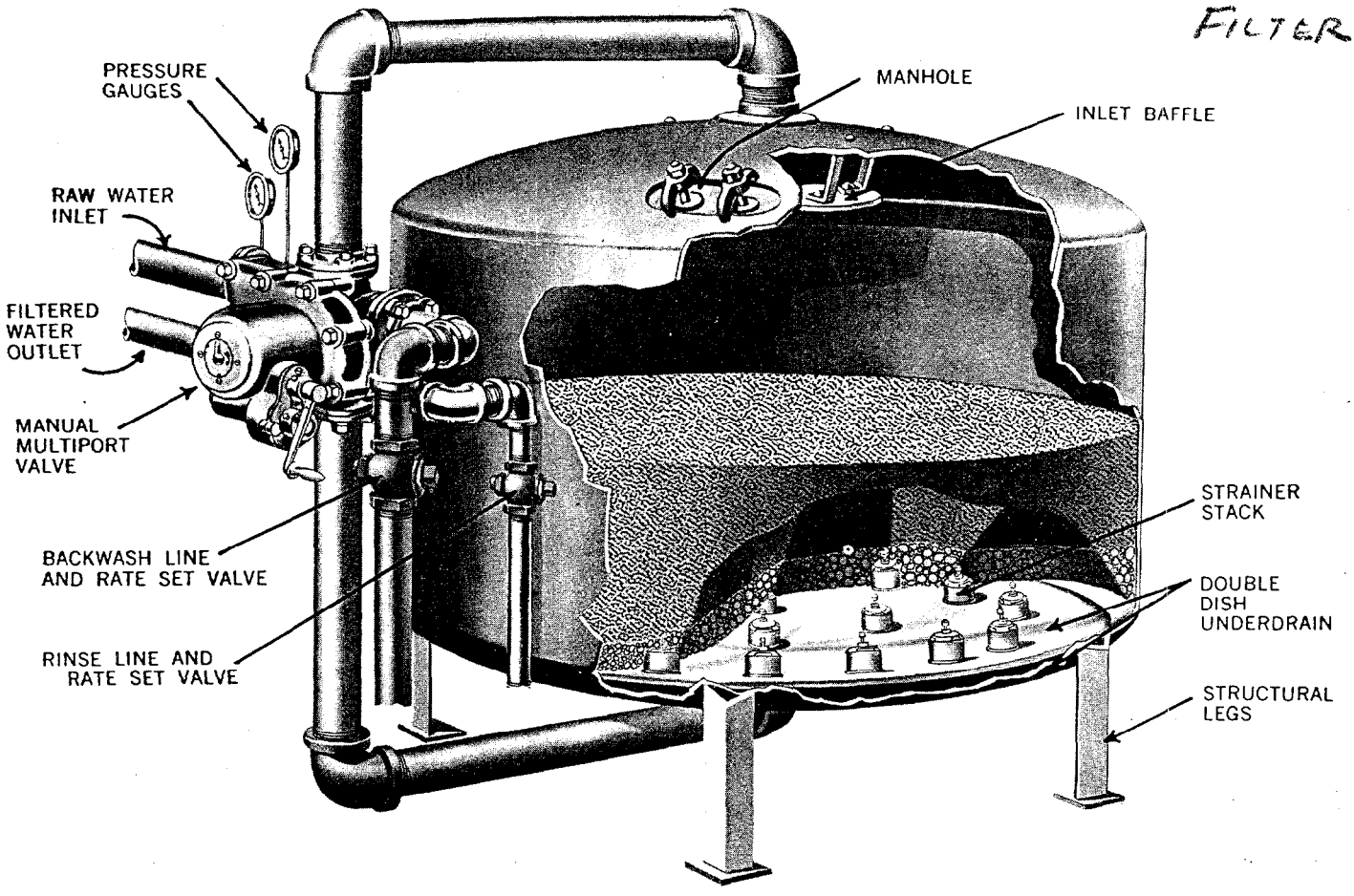
TYPICAL PRESSURE FILTER



PERMUTIT® PRESSURE FILTERS

Filters are used to remove suspended impurities from water. Prior coagulation is almost invariably necessary. If the turbidity is very low and color removal is not involved, coagulation without settling may be employed. Where raw water turbidity is high or color removal is required, coagulation plus settling should precede the filters, using clarifying equipment such as the Permutit Precipitator, Permujet, or floc-formers and settling basins. Among the most common impurities thus removed are dirt, turbidity, iron, oil and color. Filters with an adsorptive medium are used to remove bad taste and odor. Where water is softened, by either the hot or cold lime soda process, filters are employed to further clarify the water. Neutralite filters can be used on low pH water to raise the pH to approximately 7.1.

A pressure filter is a closed cylindrical steel shell containing a bed of granular filter medium over a collector system. The water to be filtered enters above the bed, percolates downwardly through the filter bed and is drawn off through the collector system at the bottom. Periodically this flow is reversed and the filter is backwashed to carry away the dirt which accumulates on the filter bed. Permutit pressure filters are designed in both vertical and horizontal tank types with straight heights and lengths variable to meet specific requirements. Rotary surface washers or air scour are optional for all types.

Pressure filters are used where the raw or coagulated water is supplied under pressure. Since the effluent from these filters is also under pressure, the necessity of repumping to the point of service is eliminated. They are lower in cost than gravity operated type filters of the same capacity.

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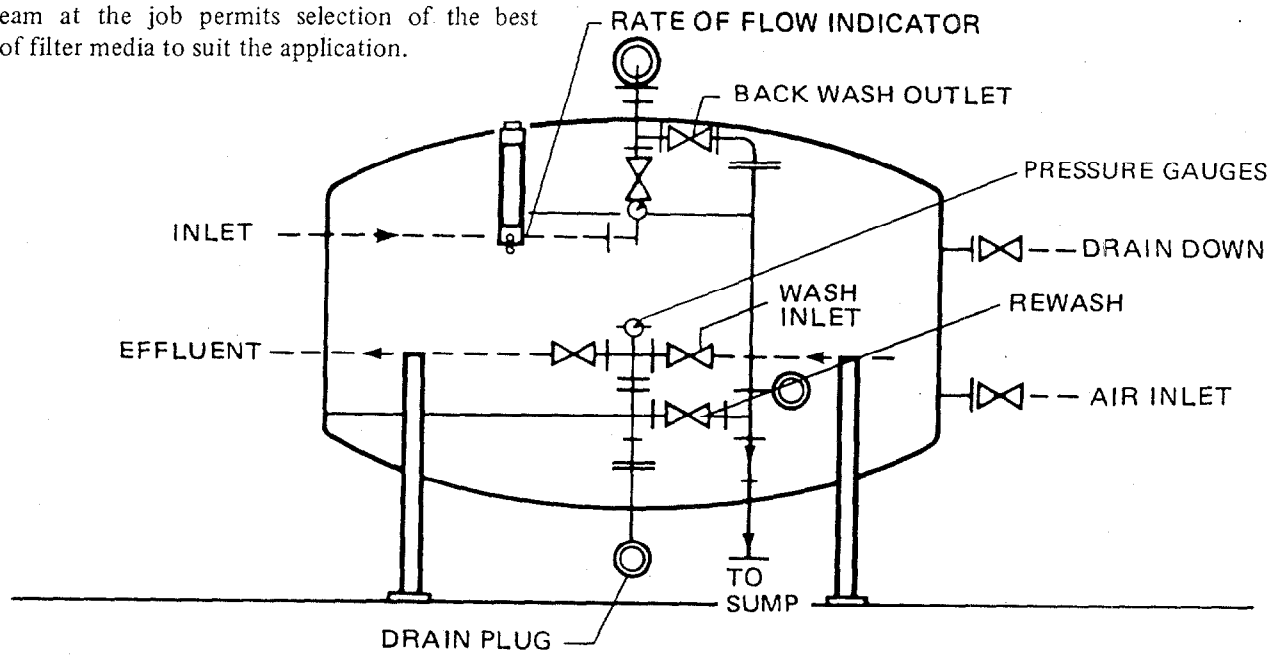
PERMUTIT AIR SCOUR PRESSURE FILTERS

Addition of the Permutit Air Scour feature and careful selection of filter media in Permutit standard vertical or horizontal pressure filters makes them suitable for the reduction of high levels of suspended solids in raw water supplies or in the final filtration of secondary clarified waste waters. The scouring action of air and water achieved by Permutit's Air Scour design loosens sticky, suspended solids which are then washed out with a following conventional water backwash. Permutit Air Scour also reduces wash water volumes. Permutit R. & D. Facilities for bench test or pilot plant test work on the water or waste stream at the job permits selection of the best combination of filter media to suit the application.



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A ZURN COMPANY

THE PERMUTIT COMPANY, INC., E49 MIDLAND AVENUE, PARAMUS, NEW JERSEY 07652

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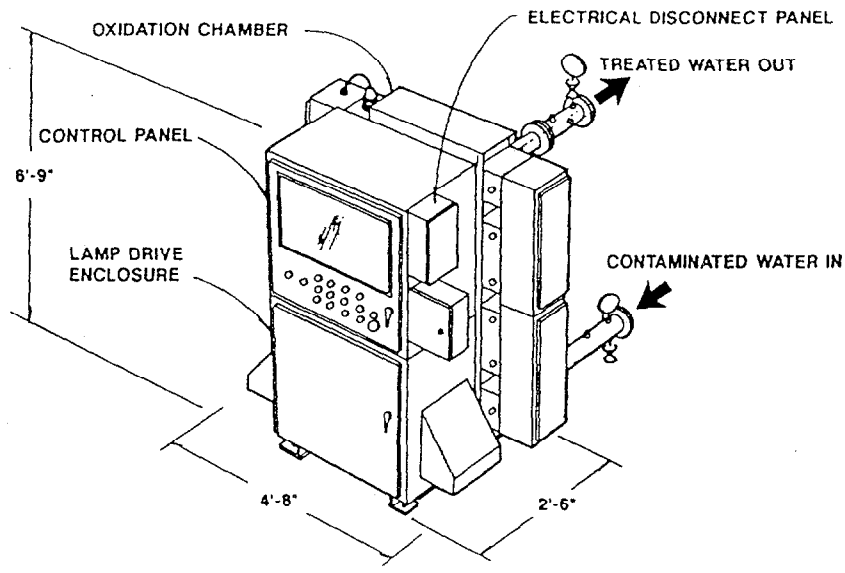
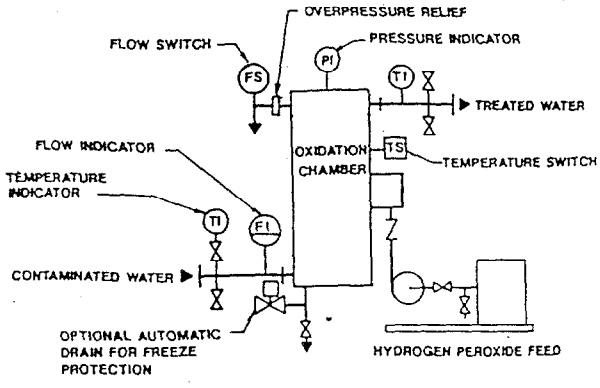
2225

TYPICAL UV/OXIDATION UNIT

MODULAR TREATMENT SYSTEMS

MODEL SSB-30





SPECIFICATIONS	Model SSB-30	
Flow Rate:		
Maximum	60 gpm	100 gpm
Connections:	150# Flange	150# Flange
Inlet:	1 1/2"	2"
Outlet:	2"	2"
Power Supply:	3 pH/60Hz/480V, 30KW, 80 Amps	
Electrical Encl.:	NEMA 3R	
Material -		
Wetted Parts:	316 SS, Quartz, Fluoroelastomers, TFE	
External Parts:	Enameled Steel	
Weight -		
Shipping:	1500 lbs.	
Operating:	2000 lbs.	

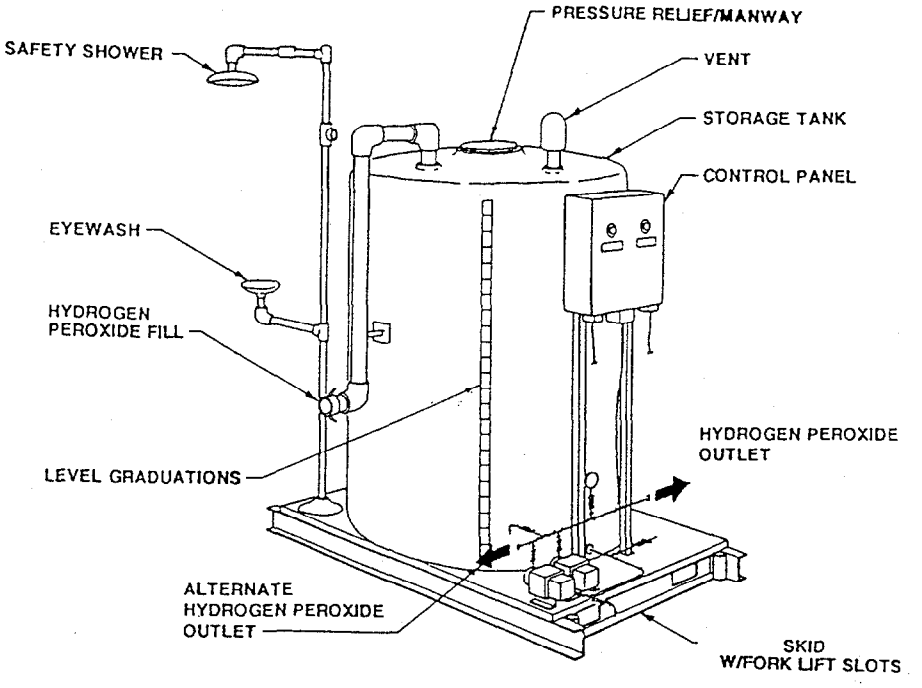
The **perox-pure™** chemical oxidation system consists of modular, skid-mounted equipment designed to treat water contaminated by dissolved organic compounds. Bench-scale process evaluations will determine pretreatment requirements (if any) and the oxidation time necessary for the desired treatment level. Full-scale oxidation chamber volume, UV requirements and oxidant dosage are then selected.

The **perox-pure™** system incorporates corrosion resistant fluorocarbon-lined oxidation chambers and horizontally mounted medium pressure UV lamps. Indicators are provided to monitor performance of each lamp. A sequential hydrogen peroxide addition feature provides easy process optimization for maximum economy. In addition, a patented tube cleaning device maximizes performance and minimizes maintenance time. The cleaning device is automatic and self propelled, requiring no external actuating mechanism or sliding shaft seals. Other design features include shop-wired and tested control panels interlocked with personnel and process safety features to shut-off power and display the cause at preset conditions. Installation is quick and easy.

The **perox-pure™** system and its components are covered by numerous issued and pending patents.

HYDROGEN PEROXIDE STORAGE/FEED MODULE

MODEL PM -500B



SPECIFICATIONS

Working Capacity:	500 Gal.
Outlet Connection:	1/4" Tube Fitting
Length:	5'-4"
Width:	4'-0"
Max Height:	7'-9"
Power Supply:	1 ph/60 Hz/120 V (110 Watts peak per pump)
Pumps:	
Qty:	Two (2)
Type:	Positive displacement, diaphragm
Control:	(2) HOA switches in Control Panel
Capacity:	To meet application
Material:	
Wetted Parts:	High Density Cross-Linked Polyethylene, with UV Inhibitors, Fluoroelastomer, PTFE, PVC, Stainless Steel
Exterior Parts:	Enamelled Steel
Weight:	500 lbs Empty 5500 lbs Full

*Alternate Arrangements Available

Peroxidation Systems Inc.

5151 E. Broadway, Suite 600 Tucson, Arizona 85711 602-790-8383 FAX 602-790-8008

TYPICAL GAC UNIT

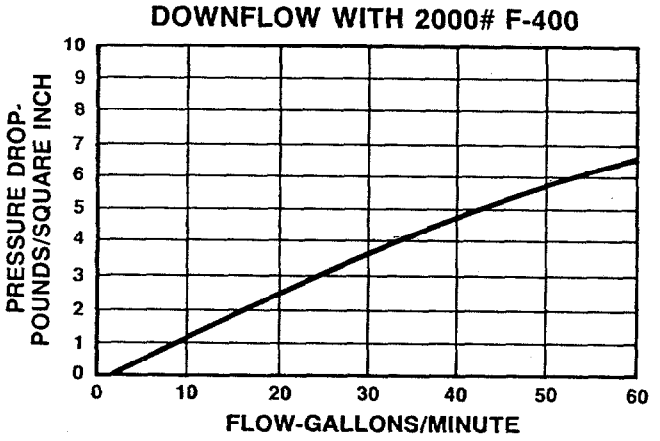
CALGON CARBON CORPORATION

CYCLESORB SERVICE℠

CARBON TREATMENT AND SPENT CARBON RETURN SERVICE

The Calgon Carbon Cyclesorb Adsorption Service is provided to offer users of small amounts of granular activated carbon the convenience of both having an easy-to-use adsorber and the capability to return the spent carbon for safe handling by reactivation. Cyclesorb utilizes adsorption with granular activated carbon, a proven and widely used treatment technology, for removal of dissolved organic contaminants from water and wastewater. The Cyclesorb Service is well suited for moderate flows of limited duration such as pump tests, groundwater treatment and intermittent wastewater sources, or treating finite amounts of contaminated water from spills, lagoons or storage tanks.

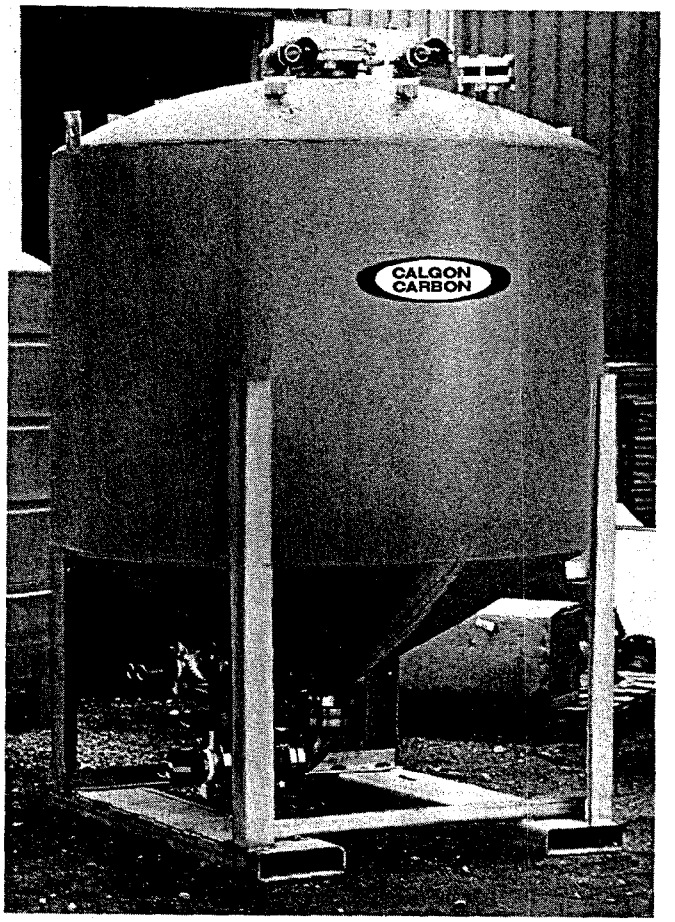
Your Calgon Carbon Technical Sales Representative can help you evaluate the suitability of the Cyclesorb Service to meet your treatment requirements. If needed, adsorption evaluation tests to determine applicability and economics can be arranged. Calgon Carbon offers adsorption equipment in many other sizes, and carbon supply and reactivation exchange services to meet your particular needs.



THE CYCLESORB ADSORBER

The adsorber is a non-pressure unit, constructed of type 316 stainless steel and EPR gaskets. The adsorber is designed to contain up to 2,000 pounds of a selected grade of Calgon Carbon granular activated carbon.

The adsorber, weighing 5,600 pounds for shipping and handling and 7,400 pounds in operation, can be transported via forklift and set on a level area for operation. The unit is 5 ft. in diameter with an overall height of 7 ft. 3 inches. The influent and effluent connections are conveniently made with 2″ Kamlock hose connections. The untreated water, at flows up to 60 gpm, enters the top of the unit, flows down through the carbon bed, is collected by a screened outlet and exits the side of the coned section. Sample taps are provided on the influent and effluent connections.



The proper flow through the Cyclesorb is determined by the necessary contact time for the treatment process. The Cyclesorb Adsorbers can be arranged in parallel for increased flows, or in series to take advantage of closer to optimum carbon usage.

The adsorbers are not to be operated above 15 psig, and a rupture disk is included to assure that this pressure is not exceeded.

THE ADSORPTION SERVICE

The user of the adsorption service has the convenience of using the Cyclesorb Adsorber for treatment, and then using the unit as a shipment container to return the spent carbon to Calgon Carbon.

The spent carbon can be returned to Calgon Carbon if it is accepted for thermal reactivation. An acceptability test is conducted on a small carbon sample supplied with the initial Cyclesorb Adsorber, exposed to the water or waste water to simulate spent carbon characteristics. The Calgon Carbon Technical Sales Representative can provide additional information on acceptance of spent carbons.

If the spent GAC has been tested and accepted by Calgon Carbon, the Cyclesorb can be returned to Calgon Carbon, after the spent Cyclesorb is drained of free water. Upon return, the spent GAC will be removed from the unit and thermally reactivated.

If further on-site treatment is required, the spent Cyclesorb can be replaced with a fresh Cyclesorb, with the simple hose connections utilized to switch units.

SPECIFICATIONS

Adsorber Diameter	5 ft.
Unit Height	7 ft. 3 in.
Material of Construction	Type 316 Stainless Steel
Gasket Material	EPR
Operating Pressure/Relief	15 psig (no vacuum)
Hose Connections	2″ Kamlock (process)
	½″ FNPT (sample)
Carbon Volume	71 cubic feet (2,000 pounds)
Flow Rate	0-60 gpm
Weight	Empty-1,040 lbs.
	Filled Dry-3,035 lbs.
	Operating-7,400 lbs.
	Max Return (Drained)-5,600 lbs.

CAUTION

Wet activated carbon preferentially removes oxygen from the air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable Federal and State requirements.

For information regarding human and environmental exposure, call (412) 787-6700 and request to speak to Regulatory and Trade Affairs.

Calgon Carbon Corporation reserves the right to change specifications without notice for components of equal quality.

For additional information, contact Calgon Carbon Corporation, Box 717, Pittsburgh, PA 15230-0717 Phone (412) 787-6700.

CALGON

CALGON CARBON CORPORATION

TYPICAL FILTER PRESS

MET-CHEM INC.® Filter

EXCELLENT QUALITY • LOW PRICES •

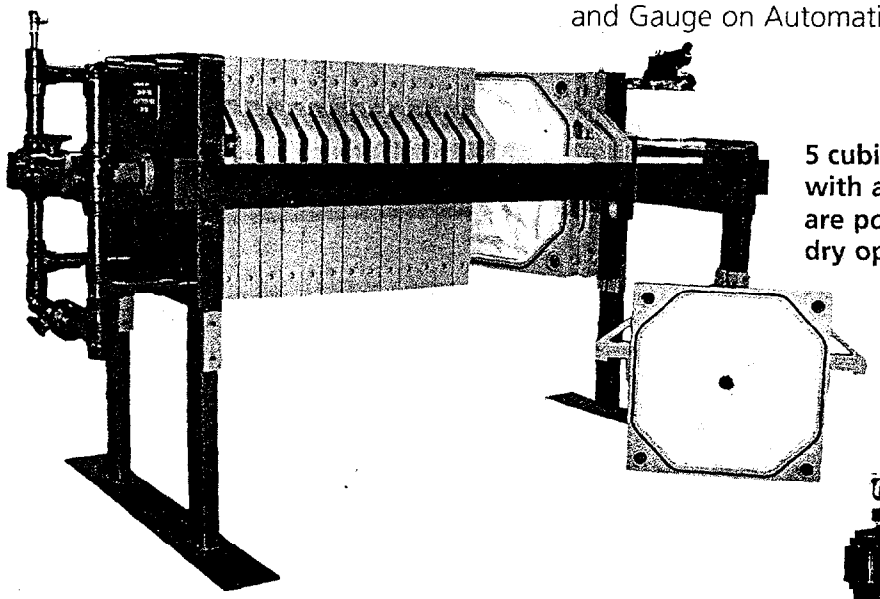
Met-Chem Filter Presses feature heavy duty steel construction with polypro gasketed plates. Presses can be manufactured with manual or automatic closures, but always with a hydraulic cylinder for sure, high pressure closing. Met-Chem's filter presses are always expandable for larger future capacity.

STANDARD FEATURES:

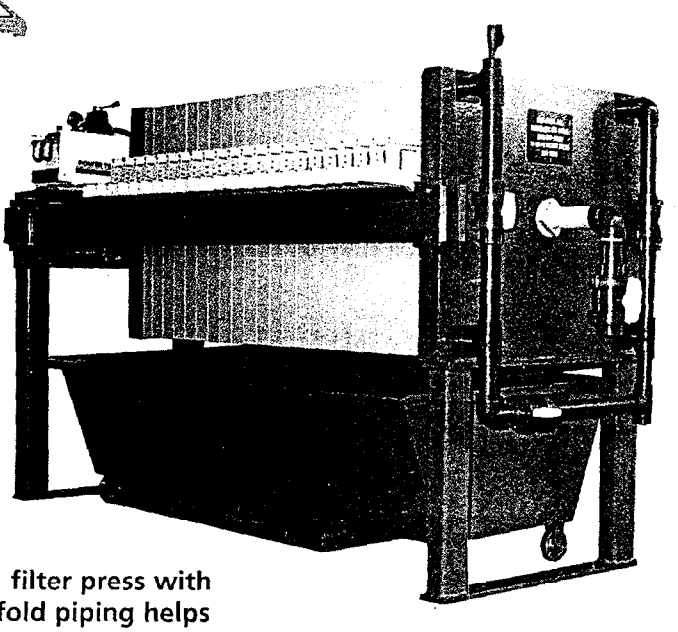
- Air Driven Hydraulic Closing Pump with Pressure Gauge on Automatic Units
- 2 Stage Hand Pump on Manual Units
- Heavy Duty Hydraulic Cylinder for Opening and Closing of Press
- Polypro Gasketed Recessed Plates for Leak Free Operation
- Air Blow Down Manifold Piping for Air Drying Filter Cakes
- Air Line Filter, Oiler, Regulator, and Gauge on Automatic Units

OPTIONAL FEATURES:

- Sludge Dump Carts for Sludge Collecting and Dumping
- Cat-Walk Platform with Raised Legs for Disposal into Drums or Our Sludge Dryer
- Automatic Plate Shifter for Ease of Cleaning
- Distance Piece for Future Expansion
- Leg Mounted Control Panel
- Diaphragm Pump for Solids Feed to the Filter Press



5 cubic foot 630mm filter press with automatic closure. Plates are polypro with gaskets for dry operation.



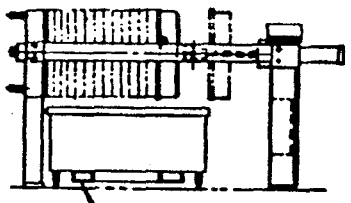
10 cubic foot 800mm filter press with air blow-down manifold piping helps us achieve the driest cake possible. Shown with optional dump cart.

OUR FILTER PRESSES HAVE BEEN USED ON:

- Dewatering Sludges from Industry
- Reclaiming Precious Metals
- Processing of Pharmaceuticals
- Product Filtration
- Dewatering Hazardous Wastes
- Process Waste Waters in EPA Approved Treatment Systems

TYPICAL FILTER PRESS

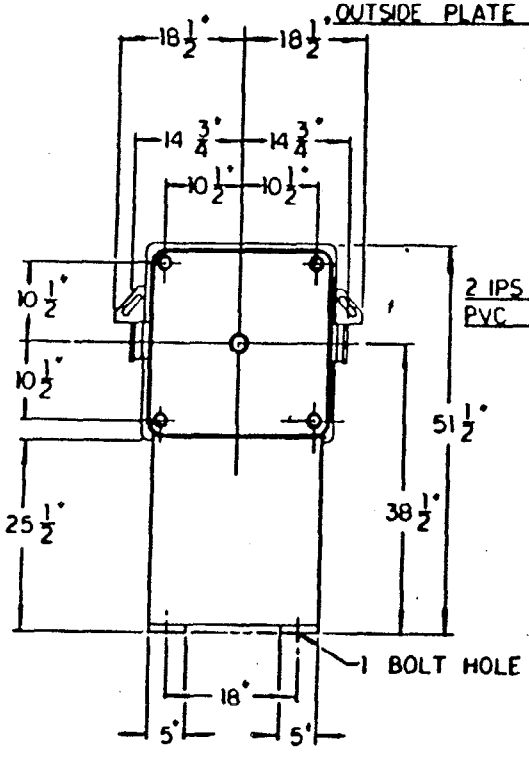
PLATES TO BE CENTER FEED 4 CORNER DISCHARGE. PLATES OF POLYPROPYLENE GASKETED CONSTRUCTION WITH $\frac{5}{8}$" RECESSES FOR $1\frac{1}{4}$" THICK CAKES

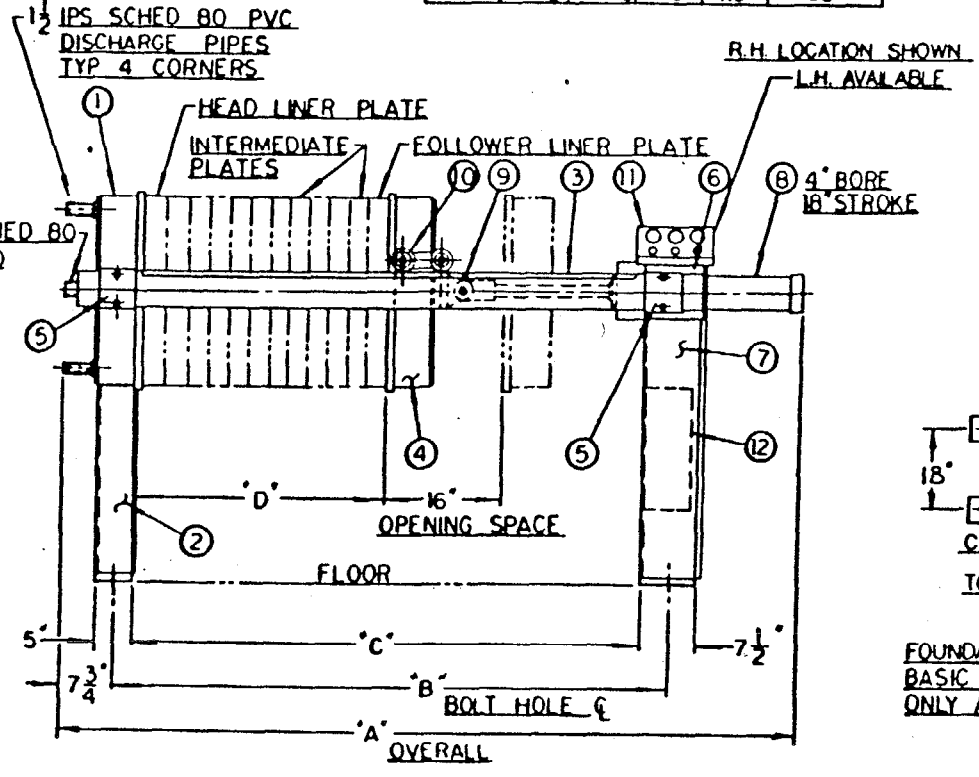


FILTER CAKE DUMPSTER (SELF DUMPING) OPTIONAL

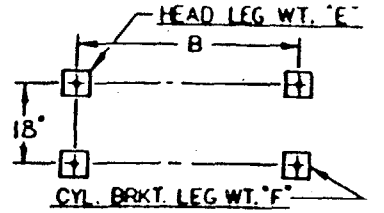
24" SIZE (630 MM) FILTER PRESS					
CUBIC FEET	A	B	C	D	NO OF CHAMBERS
1	75 1/2	49 1/4	43	9	3
1.5	80 3/4	54 1/2	48 1/4	14 1/4	5
2	84	57 3/4	51 1/2	17 1/2	7
3	91	64 3/4	58 1/2	24 1/2	10
4	97 3/4	71 1/2	65 1/4	31 1/4	13
5	106 3/4	80 1/2	74 1/4	40 1/4	17
6	113 1/2	87 1/4	81	47	20
8	129 1/4	103	96 3/4	62 3/4	27
10	142 3/4	116 1/2	110 1/4	76 1/4	33
12	159 1/4	133	126 3/4	92 3/4	40
13	170	143 3/4	137 1/2	103 1/2	43
15	181 1/2	155 1/4	149	115	50

ITEM NO	QUAN	DESCRIPTION
1	1	HEAD
2	1	HEAD LEG
3	2	SIDE BAR
4	1	FOLLOWER
5	4	JOGGLE PLATE
6	1	CYLINDER BRACKET
7	1	CYLINDER BRACKET LEG
8	1	CYLINDER
9	2	SS SIDE BAR CAPS
10	3	FOLLOWER ROLLER
11	1	CONTROL CENTER
12	1	HYDRAULIC PUMPING UNIT





WEIGHT IN POUNDS			
CUBIC FEET	E	F	G
1	1208	806	2014
1.5	1274	849	2123
2	1336	891	2227
3	1445	963	2408
4	1553	1036	2589
5	1681	1121	2802
6	1789	1193	2982
8	2026	1350	3376
10	2242	1495	3737
12	2480	1653	4133
13	2595	1730	4325
15	2824	1883	4707



FOUNDATION DIMENSIONS ARE FOR BASIC LAYOUT ONLY. GROUT BOLTS ONLY AFTER INSTALLATION OF PRESS

JNI

630MM (24") FILTER PRESS

10873004

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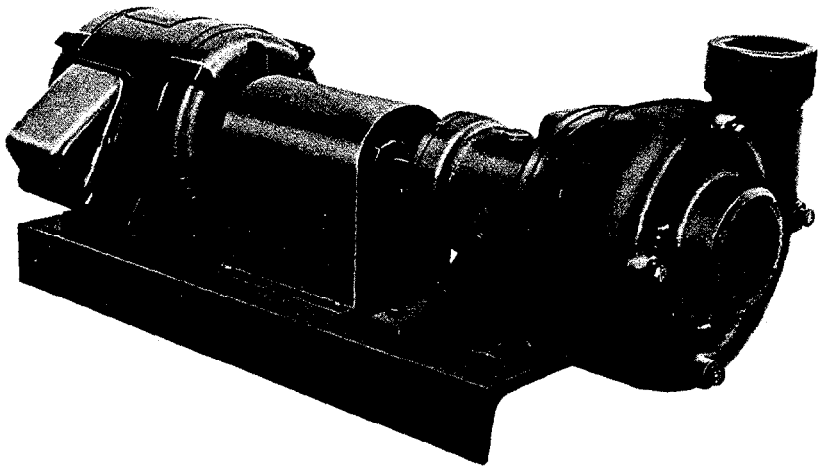


Goulds Frame-Mounted Centrifugal Pumps

MODEL

3756

S-Group

FEATURES

Frame Mounted Design: Flexibility of installation and driver arrangements.

Back Pull-Out Design: Simplifies maintenance when used with spacer type coupling.

Materials of Construction: Available in all iron, bronze fitted or all bronze material for maximum application flexibility.

Replaceable Wearing Components:
- AISI Type 303 stainless steel shaft sleeve.
- Iron or bronze casing wear ring.

Designed For Maximum Efficiency: Enclosed impeller design, dynamic balancing and renewable wear rings reduce losses affecting performance and pump life.

Suction and Discharge Pipe Connections: Threaded NPT connections EXCEPT 3 x 4-7 Model only with 125 lb. ANSI flat faced flanges.

Cast Iron Power Frame: Rigidly supported, grease lubricated ball bearing assembly.

Mechanical Seal: Standard John Crane Type 21 mechanical seal.

Drive Motors: Standard NEMA Design T-Frame motors in 1 or 3 phase.

SPECIFICATIONS

Capacities to:
550 GPM (125 m^3/hr) at 3500 RPM
200 GPM (45 m^3/hr) at 1750 RPM

Heads to:
280 ft. TDH (85m) at 3500 RPM
67 ft. TDH (20m) at 1750 RPM

Working Pressure:
175 PSIG (12 bars)

Maximum Suction Pressure to:
100 PSIG (7 bars)

Maximum Temperatures to:
212°F (100°C) with standard seal
OR
250°F (121°C) with optional high temperature seal for water applications.

Direction Of Rotation: Clockwise when viewed from motor end.

Driver Equipment:
- Motor (Goulds' choice): NEMA standard T-Frame design, 60 Hz. Available as standard selections:
  - ODP Enclosure—
    - 1 phase—3500 RPM, 3 and 5 HP
      1750 RPM, 1–5 HP
    - 3 phase—3500 RPM, 3–10 HP
      1750 RPM, 1–5 HP
  - TEFC Enclosures:
    - 1 phase—3500 RPM, 3 and 5 HP
      1750 RPM, 1–5 HP
    - 3 phase—3500 RPM, 3–10 HP
      1750 RPM, 1–5 HP

NOTE: Overload protection must be provided. Contactor with overload for single phase and starter with heaters for 3 phase must be ordered separately.

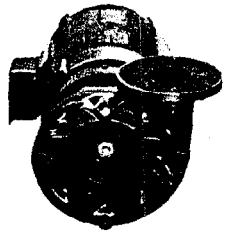
- Coupling: T.B. Wood's "SC" Spacer type or equal.
- Baseplate and Coupling Guard: Rigid steel construction in standard unit configurations for 143T through 215T frame motors. For baseplate selections using NEMA T-Frames not shown consult factory.

Motors: OPTIONAL 143T through 215T frame motors are available in ODP or TEFC enclosures. Manufacturer, Goulds' choice. Consult catalog price list for motor availability.

Mechanical Seals: Standard ceramic/carbon faces, 316 SS metal components and Buna-N elastomers. Optional high temperature and severe duty seal materials are available.

APPLICATIONS

Specifically designed for:
- Water circulation
- Booster service
- Liquid transfer
- Spraying systems
- Irrigation
- General purpose pumping



125 lb. Flanged Connections 3 x 4-7 Model Only

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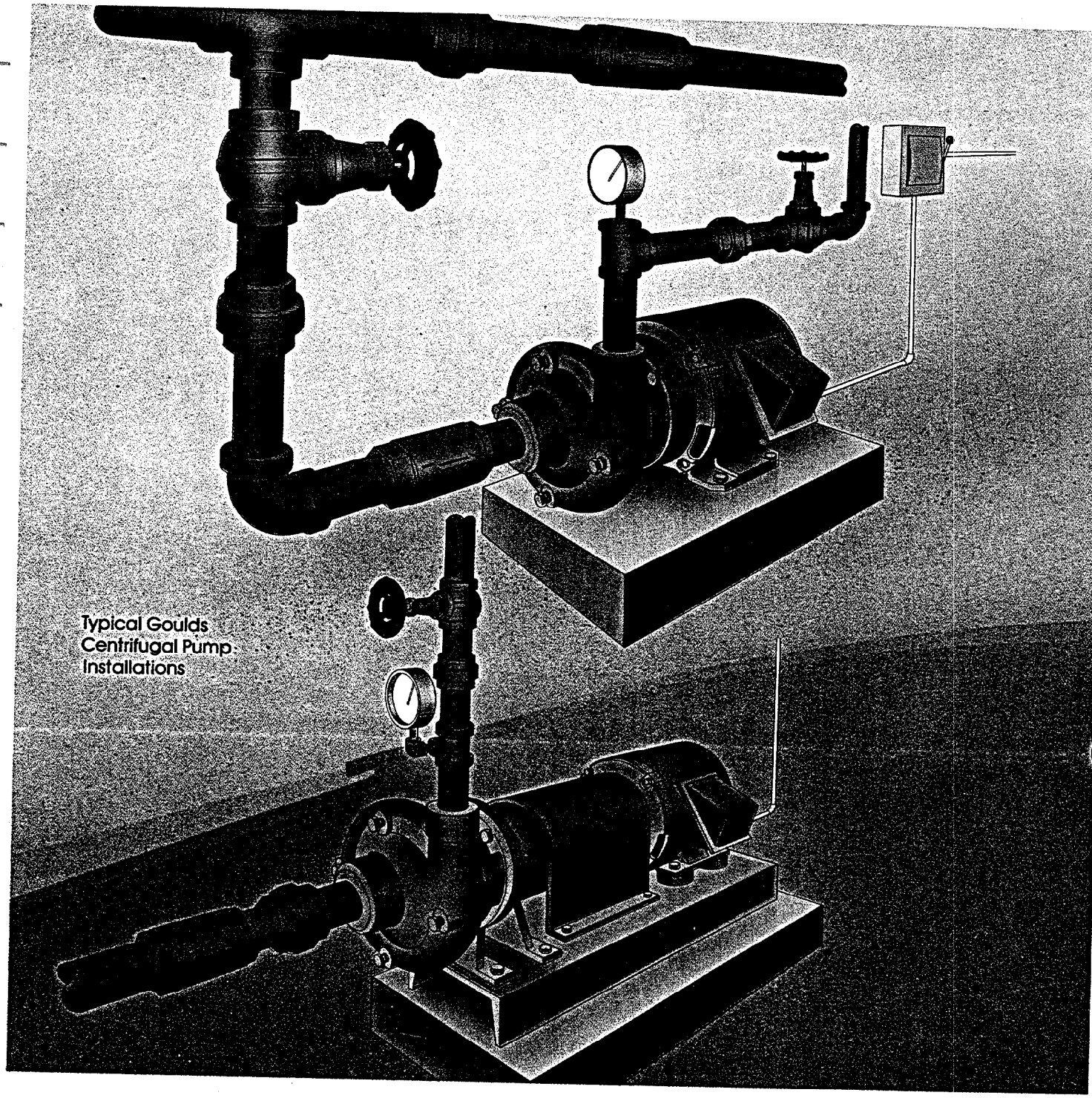
Effective June, 1992
B3756S



GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK 13148

TYPICAL TRANSFER PUMP

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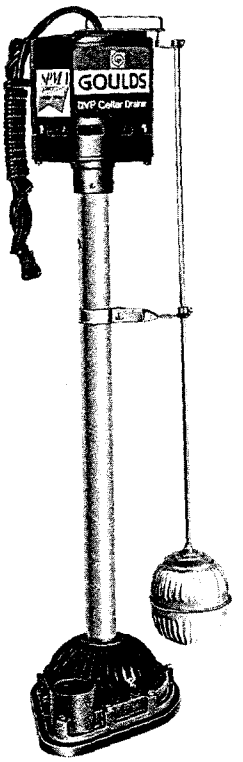
FORM WS853-7



Goulds Vertical Sump Pumps

MODEL

DVP

APPLICATIONS

Specifically designed for the following uses:

- Basement draining
- Water transfer
- Dewatering

SPECIFICATIONS

Pump:

- Discharge: 1¼" NPT, will accept adapter for 1½" discharge pipe.
- Power cord: Heavy duty 8 ft., 3-wire cord.
- Temperature: 160° F (71° C) maximum
- Sump diameter: 12 inches or larger

Motor:

- ⅓ HP, 115 volt, 60 Hz single phase 1725 RPM with built-in overload protection and automatic reset.
- 6.0 Amps maximum

FEATURES

Top-Side Suction: Positioning of suction strainer in top of casing eliminates impeller clogging from debris in bottom of sump.

Powered for Continuous Operation: All ratings are within the working limits of the motor.

Corrosion Resistant Construction: Plastic semi-open impeller, strainer, base, casing, brass column pipe, stainless steel shaft.

Float Actuated Switch.

©1985 Goulds Pumps, Inc.

EATURES

Heavy duty fiberglass construction th 3/16" wall thickness (min.). Designed to withstand hydrostatic pressure of 120 lbs. per cu. ft.

Available sizes:

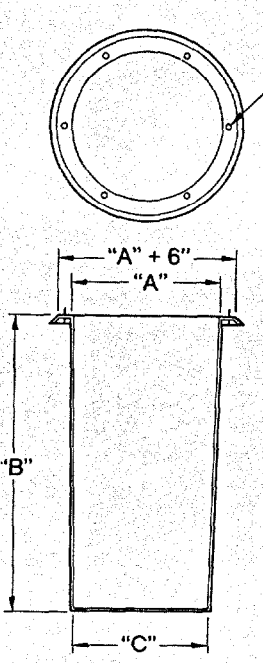
- 24" through 72" diameters
- Lengths up to 96 inches

OTE: Contact factory for pricing on nk sizes not listed

Inlet hubs available

- 4", 6", and 8" cast iron caulking type
- 4" pipe grommet type

Anti-floatation collar provided as standard on basins 78 inches and deeper. Available as an option on basins 36 to 72 inches deep.



Goulds

Effluent and Sewage

FIBERGLASS

Basins

FOR SUMP BASIN

EWAGE BASINS SIZES

rder No.	Dimensional Data A	B	C	D	Approx. Total Gals.	Gal. Per Inch	Wt.
A7-2436	24	36	22		65	1.81	37
A7-2448	24	48	21.3		84	1.75	45
A7-2460	24	60	20.7	26.5	102	1.70	69
A7-2472	24	72	20		118	1.64	79
A7-2484	24	84	24		165	1.96	92
A7-2496	24	96	24		188	1.96	105
A7-3036	30	36	28.5		110	3.00	46
A7-3048	30	48	28		137	2.85	59
A7-3060	30	60	27.5	32.5	169	2.82	90
A7-3072	30	72	27		199	2.76	104
A7-3084	30	84	30		257	3.05	118
A7-3096	30	96	30		294	3.06	134
A7-3636	36	36	34.5		159	4.41	64
A7-3648	36	48	34		200	4.17	94
A7-3660	36	60	33.5	38.5	246	4.10	111
A7-3672	36	72	33		291	4.04	128
A7-3684	36	84	36		370	4.40	188
A7-3696	36	96	36		423	4.40	211
A7-4248	42	48	40		274	5.71	112
A7-4260	42	60	39.5		339	5.65	133
A7-4272	42	72	39	44.5	402	5.58	157
A7-4284	42	84	42		504	6.00	223
A7-4206	42	96	42		576	6.00	251

imensions in inches, weight in pounds.

Order No.	Dimensional Data A	B	C	D	Approx. Total Gals.	Gal. Per Inch	Wt.
A7-4848	48	48	46		361	7.52	165
A7-4860	48	60	45.5		446	7.43	194
A7-4872	48	72	45	51	529	7.34	223
A7-4884	48	84	48		658	7.83	266
A7-4896	48	96	48		752	7.83	304
A7-5478	54	78	54		773	9.91	390
A7-5484	54	84	54	57	833	9.91	415
A7-5496	54	96	54		952	9.91	464
A7-6078	60	78	60		955	15.91	441
A7-6084	60	84	60	63	1028	12.23	468
A7-6096	60	96	60		1175	12.23	523
A7-7278	72	78	72		1375	17.62	648
A7-7284	72	84	72	75	1481	17.63	691
A7-7296	72	96	72		1692	17.63	776

NOTE: Consult factory for sizes not shown.

Bottom Anti-Floatation Collar

Order No.	Basin Size	Order No.	Basin Size
A7-24C	24"	A7-48C	48"
A7-30C	30"	A7-54C	54"
A7-36C	36"	A7-60C	60"
A7-42C	42"	A7-72C	72"

NOTE: If required must be ordered with basin.

Discharge Hubs

(Through Basin Wall, Female NPT Coupling)

Order No.	Size	Weight
A8-12	1¼"	3
A8-15	1½"	3
A8-20	2"	3
A8-30	3	8
A8-40	4	10

INLET HUBS

Part No.	Inlet Size	Construction Material	Type
A84U	4"	Thermoplastic	Pipe Grommet
A8-4	4"	Cast Iron	Caulking
A8-6	6"	Cast Iron	Caulking
A8-8	8"	Cast Iron	Caulking

- Inlets include gasket and 4 fasteners for mounting to wall of basin.
- C.I. caulking hubs recommended for C.I., or ceramic gravity sewer pipe.
- A84U adapter hubs recommended for steel PVC, or ABS gravity sewer pipe.
- A84U adapters available for 24", 30" and 36" basins only.
- A84U is corrosion resistant thermoplastic.

SENECA FALLS, NEW YORK 13148

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

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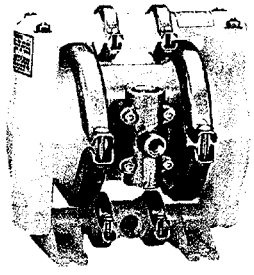
TYPICAL AIR DIAPHRAGM PUMP

M-1
NOW AVAILABLE IN ALUMINUM & STAINLESS STEEL

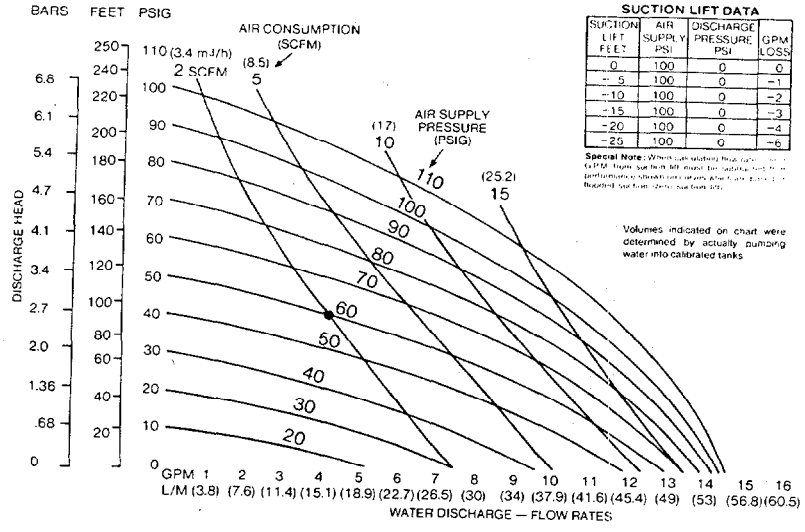


WILDEN® MODEL M1®

Height 8½
Width 8
Depth 6½
Weight ..... 8 lbs.
Air Inlet .... ¼" Female N.P.T.
Inlet ..... ½" Female N.P.T.
Outlet .... ½" Female N.P.T.
Suction Lift POLY { 15' Dry / 25' Wet
TEFLON { 8' – 10' Dry / 25' Primed
Max. Size Solids .. ⅛" Dia.

Example: *To pump 4 gpm against a discharge pressure of 40 psig requires 60 psig and 2 scfm air consumption. (See dot on chart.)*

Caution: Do not exceed 100 psig air supply pressure.



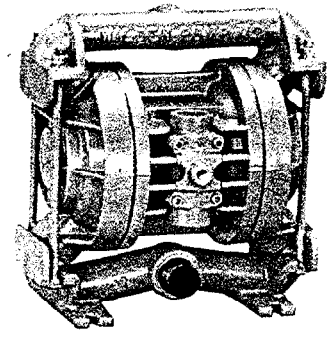
SUCTION LIFT DATA

SUCTION LIFT FEET	AIR SUPPLY PSI	DISCHARGE PRESSURE PSI	GPM LOSS
0	100	0	0
–5	100	0	–1
–10	100	0	–2
–15	100	0	–3
–20	100	0	–4
–25	100	0	–6

Special Note: When calculating flow rate (GPM) from suction lift, must be subtracted from performance shown on curves which are based on flooded suction (zero suction lift).

Volumes indicated on chart were determined by actually pumping water into calibrated tanks.

M-1
For Flows to 14 GPM



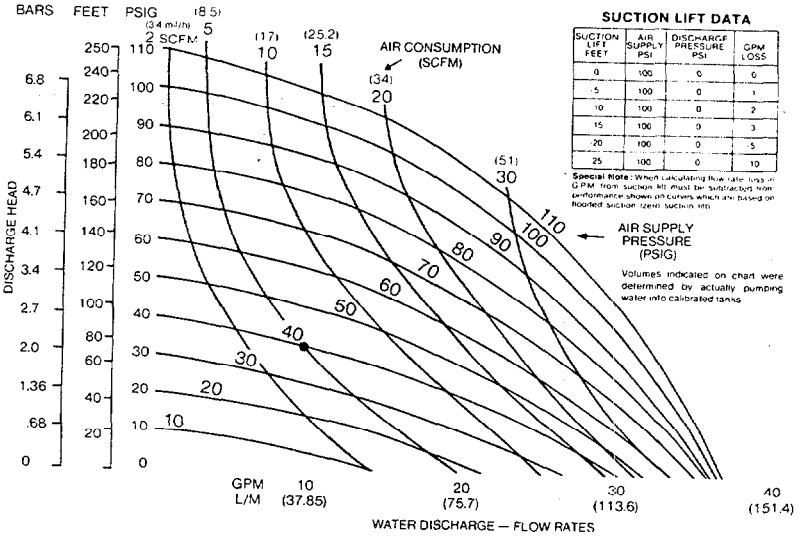
WILDEN® MODEL M2®

Height ..... 10½"
Width ..... 10½"
Depth ..... 7"
Weight .. ALUMINUM 22 lbs.
STAINLESS/HASTELLOY 35 lbs.
Air Inlet ..... ¼" N.P.T.
Inlet ..... 1" Male N.P.T.
Outlet ..... ¾" Male N.P.T.
Suction Lift ..... 18' Dry / 25' Wet
Max. Size Solids .. ⅛" Dia.

Example: *To pump 10 gpm against a discharge pressure of 35 psig requires 40 psig and 5 scfm air consumption. (See dot on chart.)*

Note: For M2 pumps fitted with Teflon diaphragms reduce water discharge figures by 20%. Suction lift for M2 pumps with Teflon diaphragms: 10 ft. dry, 25 ft. wet.

Caution: Do not exceed 125 psig air supply pressure.



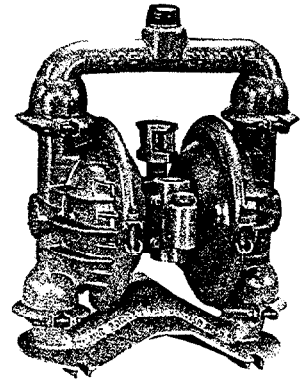
SUCTION LIFT DATA

SUCTION LIFT FEET	AIR SUPPLY PSI	DISCHARGE PRESSURE PSI	GPM LOSS
0	100	0	0
–5	100	0	–1
–10	100	0	–2
–15	100	0	–3
–20	100	0	–5
–25	100	0	–10

Special Note: When calculating flow rate (GPM) from suction lift must be subtracted from performance shown on curves which are based on flooded suction (zero suction lift).

Volumes indicated on chart were determined by actually pumping water into calibrated tanks.

M-2
For Flows to 37 GPM



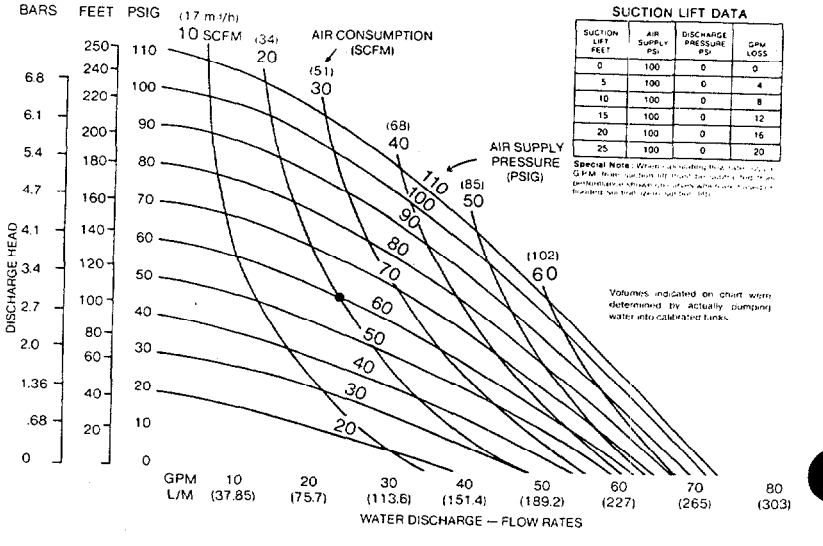
WILDEN® MODEL M4®

Height ..... 18"
Width ..... 14¼"
Depth ..... 11¾"
Weight ..... ALUMINUM 35 lbs.
IRON OR STAINLESS 52 lbs.
Air Inlet ..... ⅜" N.P.T.
Inlet .... 1½" Female N.P.T.
Outlet ..... 1¼" Male N.P.T.
Suction Lift ..... 22' Dry / 27' Wet
Max. Size Solids .. 3/16" Dia.

Example: *To pump 22.5 gpm against a discharge pressure head of 45 psig, requires 60 psig and 20 scfm air consumption. (See dot on chart.)*

Note: For M4 pumps fitted with Teflon diaphragms reduce water discharge figures by 20%. Suction lift for M4 pumps with Teflon diaphragms: 12 ft. dry, 25 ft. wet.

Caution: Do not exceed 125 psig air supply pressure.



SUCTION LIFT DATA

SUCTION LIFT FEET	AIR SUPPLY PSI	DISCHARGE PRESSURE PSI	GPM LOSS
0	100	0	0
5	100	0	4
10	100	0	8
15	100	0	12
20	100	0	16
25	100	0	20

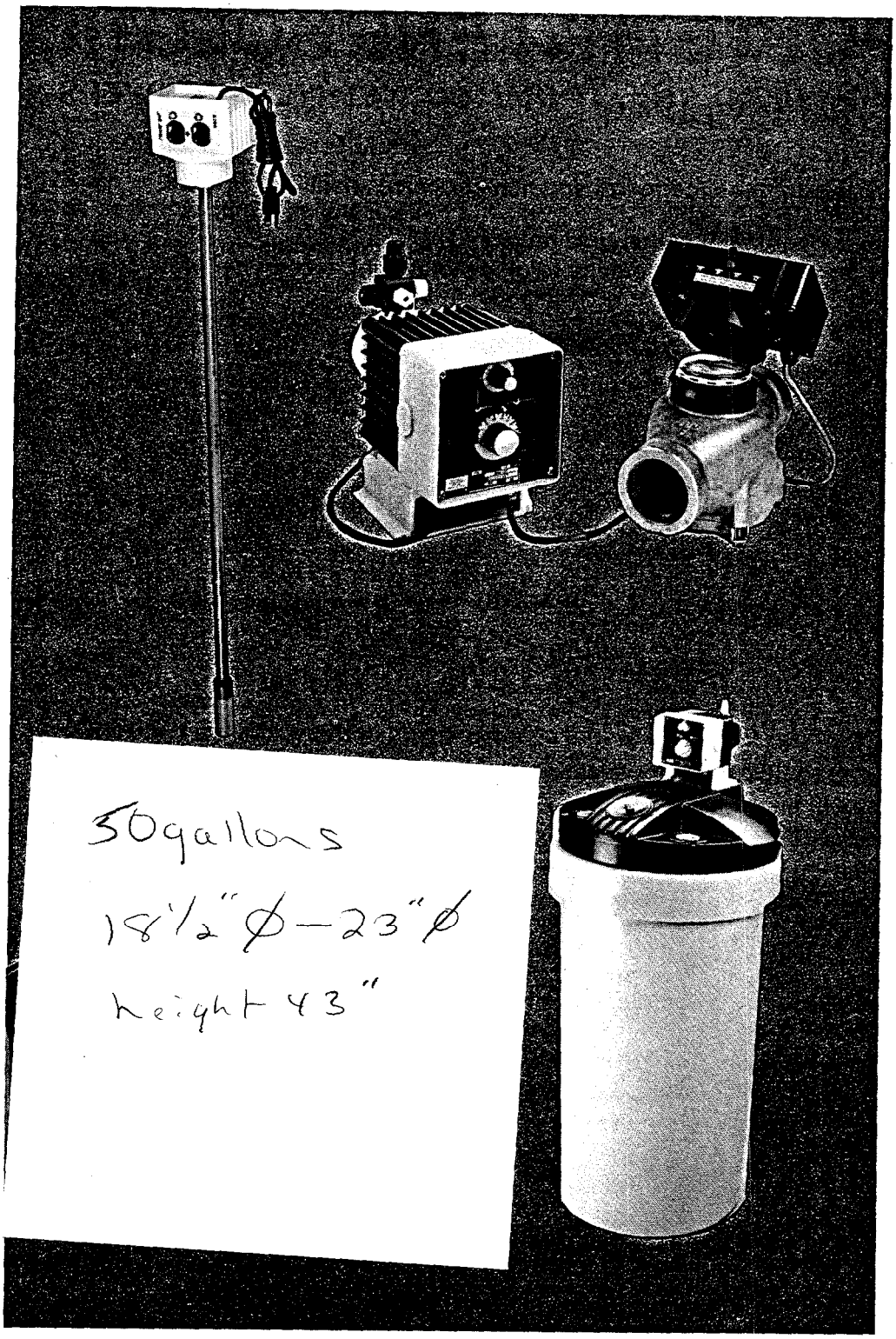
Special Note: When calculating flow rate (GPM) from suction lift must be subtracted from performance shown on curves which are based on flooded suction (zero suction lift).

Volumes indicated on chart were determined by actually pumping water into calibrated tanks.

M-4
For Flows to 73 GPM

TYPICAL CHEMICAL FEED SYSTEM

ACCESSORIES



WALCHEM

WALCHEM CORPORATION
5 Boynton Road
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Holliston, MA 01746 USA

TEL: 508-429-1110
FAX: 508-429-8737
TLX: 923478

Bulletin Sec. 3.0, pg. 1000
Replaces same of 9/86
1101.B 5A 8/88

3.6 Electrical Engineering Design

II. Electrical Engineering Calculation

Index

Item	Page
a. Electrical Load Tab	1
b. Voltage Drop Calculations	2

NETC NEWPORT TANK FARM #5

DESIGN CRITERIA

ELECTRICAL LOAD TAB

Item	Qty	Load	Fla	Volts	ph	VA	Total VA
Process							
Well Pumps	13	1/3HP	4	208	1	832	10,816
Pumps 5 HP	3	5 HP	16.7	208	3	6,016	18,048
Pumps 2 HP	7	2 HP	7.5	208	3	2,702	18,914
Pumps 1/2 HP	5	1/2HP	2.2	208	3	792	3,960
Mixers	8	1 HP	4	208	3	1,441	11,528
Uv Ox Unit	1	30 kw				30,000	30,000
Controls Sys	3	1.5kVA				1,500	4,500
HVAC							
Exhaust Fans	2	1 HP	4	208	3	1,441	2,882
Exhaust Fans	1	1/6	4.4	120	1	528	528
Furnace *	1	3/4	7.9	120	1	948	0
Water Heater	2	4600 W	22	208	1	4,600	9,200
Water Heater	2	3000	14.4	208	1	3,000	6,000
Electric							
Lighting						1,600	1,600
Misc. Power	(1 w/sf x 2,625 sf)					2,625	2,625
Receptalces	15	180				2,700	2,700
							123,301
Future Growth 100%							123,301
						Sub Total =	246,602
25% of largest piece of equipment Uv Ox @ 30 kVA x .25							7,500
						Total =	254,102

254,102 VA @ 208v 3p = 705 amps

Use 800 amp service

* Not operational in summer months (summer peak)

VOLTAGE DROP CALCULATIONS

DATE: 5\4\93 PROJECT NO: 9268 PAGE NO: 1

CIRCUIT NO/ROUTE	AMP	WIRE SIZE/TYPE	L-FT	VD-V	VD-%	PH	VOLTS
A	18.48	#2 AWG,CU	625	3.62	1.74	3	208
A1	4	#10 AWG,CU	125	1.16	0.56	1	208
B	11.55	#2 AWG,CU	325	1.18	0.57	3	208
B1	4	#10 AWG,CU	75	0.69	0.33	1	208

REMARKS: '

3.7 Facilities Protection Design

3.7 Facilities Protection Design

I. Basis of Design

With the oxidizing agent stored outside, fire sprinklers will not be required in the building. The "needed fire flow" (NFF) has been estimated according to NFPA and ISO criteria. The existing water supply system is adequate to serve the treatment building fire flow requirements with 20 psi residual pressure.

Inside the building a fire detection system will be installed and wired to the central NETC fire station.

Chain-link fencing will be installed around the building to control entry as discussed in the Civil Engineering Design section of this report.

II. Facilities Protection Calculation

Index

Item	Page
a. Fire Flow Capacity	1

TRC
TRC Environmental Corporation

INTERIM REMEDIAL ACTION
TANK FARM FIVE
NETC, NEWPORT RI
CONTRACT No N62472-92-C-0056

SHEET NO. 1 OF 2
PROJECT NO.
DATE 30 APR 1993
BY R. Nault
CHK'D

SUBJECT a. Fire Flow Capacity

The Needed Fire Flow (NFF) for the treatment building can be estimated using ISO criteria

Building Construction: $C_i = 18 \times F \times A^{0.5} = 18 \times (0.8) \times (76' \times 32)^{0.5} = 710$ GPM, SAY 750 GPM

F = 0.8 for Class 3 - non combustible (metal)

Building Occupancy: $O_i = 1.25$ conservative value

Building Exposure: $X_i = 0.08$ Nearest building exposure; $P_i = 0$

Thus $NFF = C_i \times O_i \times (1 + (X_i + P_i))$

$NFF = 750 \times 1.25 \times 1.08 = 1012$ GPM SAY 1000 GPM

From the NETC Water System Flow Test and Records of Don Wescott NETC Marshall

Water System Flow Test 2/26/93 (see map)

Testing Hydrant Static 59 psi Residual 30 psi

Flowing Hydrant 2½" nozzle 34 psi = 1088 gpm
Using a factor of 0.8 say Q = 870 gpm

TRC
TRC Environmental Corporation

PROJECT NO. _____

DATE 30 APR 1993
BY R. Nault
CHK'D _____

SUBJECT _____

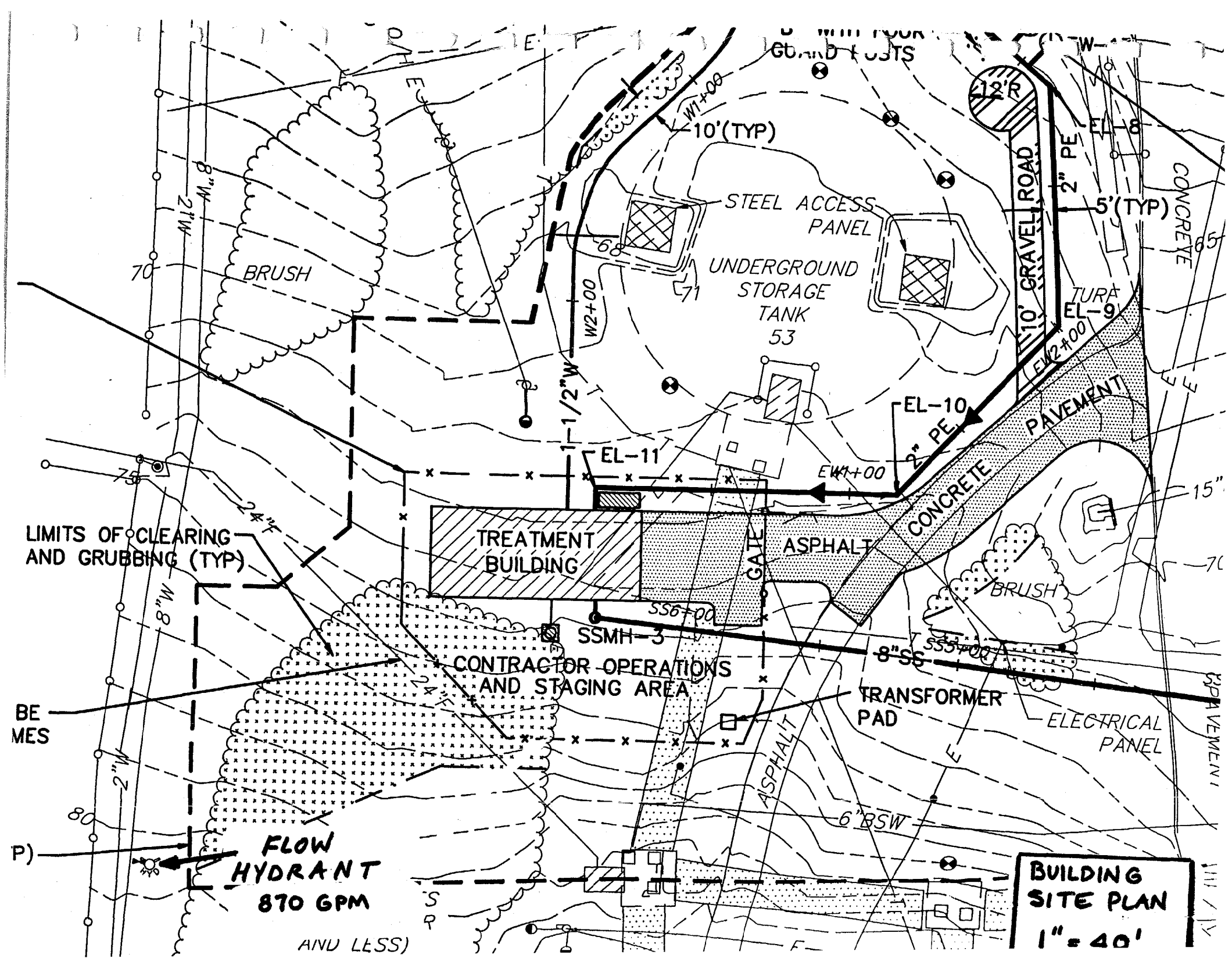
To correct for flow at a residual pressure of 20 psi:

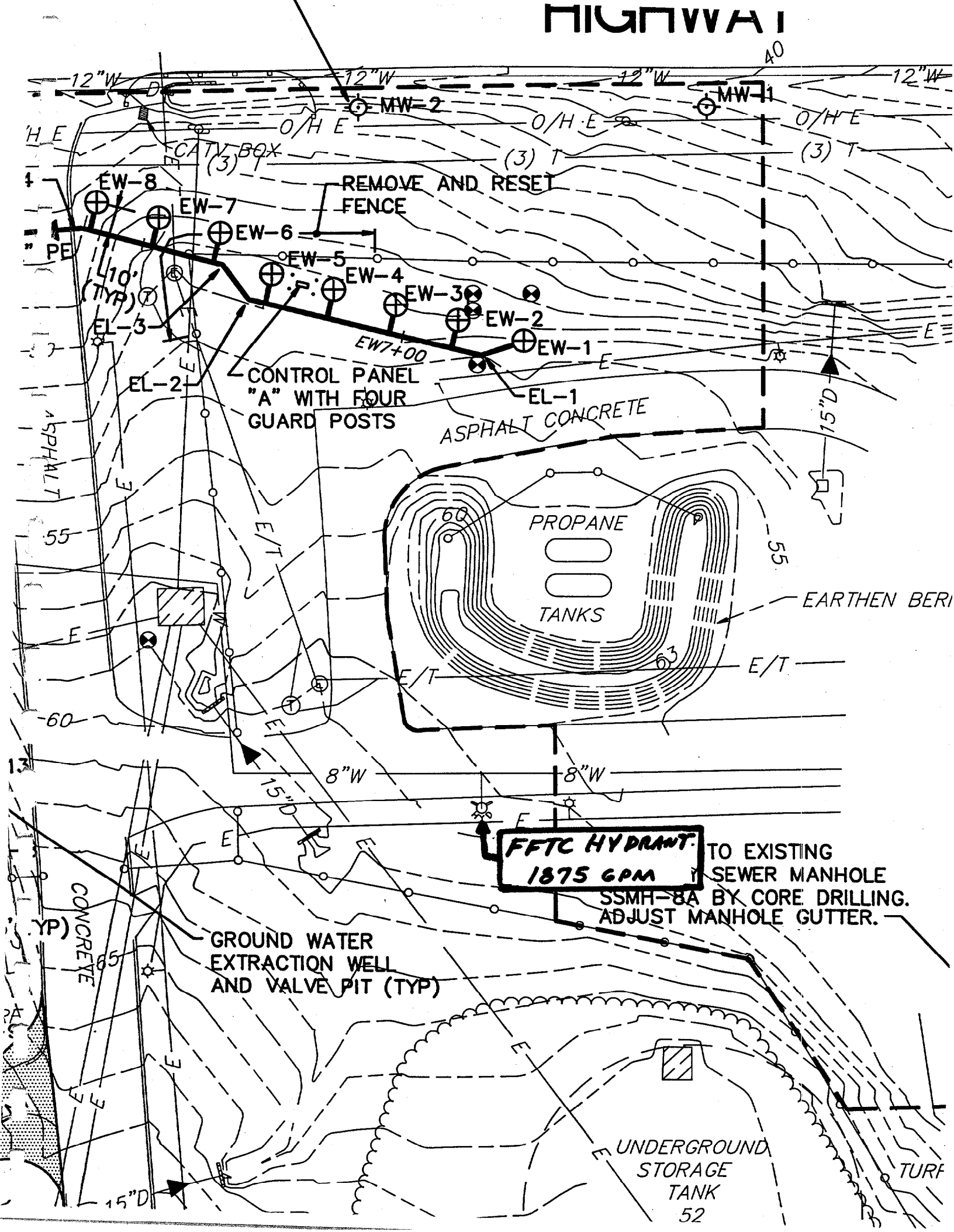
$$Q_R = \frac{Q_r \times h_r^{0.54}}{h_f^{0.54}} = \frac{870\ gpm \times (59-20)^{0.54}}{(59-30)^{0.54}}$$

$$Q_{@\ 20\ psi} = 1020\ gpm$$

The tested hydrant is within 300 ft of the treatment building and thus provides full credit of 1000 gpm towards meeting the NFF. In addition, from flow records of 10/26/91 it was found that the hydrant at the FFTC had a capacity of 1875 gpm @ 20 psi. It is between 300 - 600 ft from the treatment building and produces a credit of 670 gpm. From these records it shows that the NFF of 1000 gpm can be met with the existing water system.

The Design Drawings show the path between the treatment building and the tested hydrant will be cleared to allow easier access in the event of a fire.


STEEL ACCESS PANEL
UNDERGROUND STORAGE TANK 53
10'(TYP)
W1+00
W2+00
1-1/2"W
10' GRAVEL ROAD
2" PE
5'(TYP)
EL-8
EL-9
EL-10
EL-11
EW1+00
EW2+00
PAVEMENT
CONCRETE
ASPHALT
GATE
TREATMENT BUILDING
SSMH-3
556+00
555+00
8"SS
CONTRACTOR OPERATIONS AND STAGING AREA
TRANSFORMER PAD
ELECTRICAL PANEL
LIMITS OF CLEARING AND GRUBBING (TYP)
BRUSH
8"W
2"W
24"F
6"BSW
FLOW HYDRANT
870 GPM
BUILDING SITE PLAN
1"=40'
AND LESS)


HIGHWAY
MW-2
MW-1
O/H E
CATV BOX
(3) T
REMOVE AND RESET FENCE
EW-8
EW-7
EW-6
EW-5
EW-4
EW-3
EW-2
EW-1
EW7+00
EL-3
EL-2
EL-1
10' (TYP)
CONTROL PANEL "A" WITH FOUR GUARD POSTS
ASPHALT CONCRETE
PROPANE TANKS
EARTHEN BERM
12"W
8"W
15"D
E/T
E
FFTC HYDRANT 1875 GPM
TO EXISTING SEWER MANHOLE SSMH-8A BY CORE DRILLING. ADJUST MANHOLE GUTTER.
GROUND WATER EXTRACTION WELL AND VALVE PIT (TYP)
CONCRETE
UNDERGROUND STORAGE TANK 52
TURF

4.0 GROUND WATER REMEDIATION OPERATION AND MAINTENANCE REQUIREMENTS

4.1 Operation and Maintenance - Ground Water Extraction System

The ground water extraction system has been designed to require a minimal amount of maintenance and includes a variety of safeguards which will shut the system down in the event of a serious malfunction. However, the system will require routine checks by the operator at least one time per week and more extensive monitoring and maintenance approximately once a month. Each of the areas of operation for the ground water extraction system are described below.

4.1.1 Monitor Ground Water Extraction Rates

At least once per month, the total flow rates in each of the extraction wells should be measured by reading and recording the flow meter in the well valve pit. Water extraction rates will be measured so that well performance and hydraulic conditions in the various portions of the site can be determined.

4.1.2 Monitor Ground Water Levels

At least once per month, the water levels in each of the monitoring wells should be measured. These levels will be evaluated to determine if current pumping rates and drawdowns are sufficient to create flow gradients toward the wells throughout the area where ground water contamination exists. Pumping rates and drawdowns will be adjusted, if necessary, by adjusting the flow regulating globe valve in the well valve pit.

4.1.3 Monitor Extraction Well and Monitoring Well Water Quality

To detect the possible migration of contaminants, the ground water quality should be monitored. Extraction well water quality will be monitored inside the treatment building as influent to optimize the treatment process. Ground

water samples will be collected on a quarterly basis from the downgradient monitoring wells and analyzed for priority pollutant volatile organic compounds and metals. These results will be used in evaluating the migration of the contaminant plume and capture efficiency of the ground water extraction wells.

4.2 Operation and Maintenance - Treatment System

The treatment system has been designed to be as automated as possible with safeguards which will shut the system down in the event of malfunction. This will minimize damage to workers, equipment and the environment. A plant operator will be required to perform manual operations such as adjusting pumping rates, backwashing, operating the filter press, refilling chemical feed equipment, performing chemical analysis, etc.

The treatment system has been designed to require manned operation only one shift per day. Storage tanks and equipment have been selected to accommodate at least one days flow. This operating basis, along with a complete schedule of tasks, will be developed in an Operations and Maintenance Manual for the Treatment System.

4.2.1 Monitor Treated Water Quantity and Quality

The influent flow to the treatment building will be measured daily and recorded. Sample ports will be installed between the treatment units for water quality sampling. Daily testing of inorganic contaminants at the following points is feasible with relatively simple spectrophotometers, pH meter, mass balance and other lab equipment:

- Plant influent
- Clarifier influent
- Filter influent
- Filter effluent
- Plant effluent

Testing should be performed for metals concentration, pH, total suspended solids and hardness. Results should be recorded and analysis performed of treatment efficiencies, adjustments necessary to optimize process performance and conformance with discharge requirements.

Testing and analysis or organic contaminants for priority pollutants will be submitted to a certified laboratory. Samples should be taken at the plant effluent at a frequency consistent with the Newport POTW discharge permit conditions (typically once per month). To compare the UV/oxidation treatment efficiency with the granular activated carbon system, additional samples should be collected at the UV/oxidation influent and effluent at desired intervals (for example, once every three months).

4.2.2 Treatment Equipment Operation

The main process line of the treatment train is designed to operate automatically under normal working conditions. The plant operator will have to perform manual functions such as change over of chemical feed supplies and off-line processes such as backwashing and filter press use on an as-needed basis. Treatment equipment operation and maintenance guidelines and requirements will be developed during construction using information on actual equipment installed under this contract.

4.2.3 Treatment Equipment Maintenance

A maintenance manual for all equipment is required from the contractor that will detail suggested procedures and frequencies. The treatment process includes mechanical equipment such as pumps, valves, pipe and floats, and electrical equipment such as motors and controls. Personnel trained and experienced with this equipment will be needed to properly maintain this system.

APPENDIX A

SOIL INVESTIGATION DATA

TRC
TRC Environmental Corporation

SHEET NO. 1 OF 4
PROJECT NO. 12773
DATE 9/22/93
BY CMA
CHK'D

SUBJECT NETC NEWPORT - TANK FARM 5 IRM

SOILS REPORT & FOUNDATION ANALYSIS

Four Test Borings were drilled within the footprint of the new treatment building. Each boring penetrated to a depth of approximately 20 feet below the surface. The soils beneath the new building can be generalized as follows:

0'-2'	Brown Med. Sand & Gravel
3'-10"	Grey & Brown Grey Loose to Medium Compact Gravelly Sand and Silt
10'-15'	Brown Dense to Very Dense Sand and Silt with weathered shale fragments
15'-20'	Weathered Shale and Quartz

Ground water was not encountered.

Footings for the building will be constructed at a depth of approximately 3'to 4' below the present ground surface. The following is a summary of the blow counts for the standard penetration test at each boring at approximately 3'to 8'

BOEING #	B-1	B-2	B-3	B-4
~~Blow Counts~~ per Foot (N)	14	17	12	35

USE A VALUE OF N = 15 FOR DESIGN

TRC
TRC Environmental Corporation

SUBJECT NETC NEWPORT - TANK FARM 5 IRM

The boring logs below the 8' depth show a significant increase in blow counts and compactness, therefore the use of N=15 for footing design is ok. The building footings will be two types as follows

① Continuous footing for frost wall around building. This footing will have low load condition since it is a non-bearing support footing. An 18" wide footing will be assumed.

② Square Spread Footings for piers which support the building structural steel fixed frames. These footings typically are on the order of 5 feet square.

Computation of Allowable Bearing Capacity

From NAVFAC DM-7.2, MAY 1982, page 7.2-131
Figure 1 - Ultimate Bearing Capacity of Shallow Footings with Concentric Load

Square or Rectangular Footing:

Cohesionless Foundation

$$q_{ult} = \gamma D N_q + 0.4 \gamma B N_\gamma$$

γ - Unit weight (PCF)
ϕ - Angle of internal friction
D - Depth from Ground Surface to bottom of Footing
B - Width of Footing
N_γ, N_q - Bearing Capacity Factors

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SHEET NO. 3 OF 4
PROJECT NO. 12773
DATE 9/22/93
BY CMA
CHK'D

SUBJECT NETC NEWPORT – TANK FARM 5 IRM

BASED ON THE GRADATION CURVES FOR S-1 (5'-7') from Boring B-3 and S-2 (8'-10') from Boring B-2 and the Atterberg Limits

	S-1/B-1	S-1/B-2
LL	24	22
PL	17	18
PI	7	4

Assume $\gamma = 105$ pcf

The soil meets the definition of a SM soil – Silty sands, sand-silt mixtures and is a borderline case of a SM-SC soil

Assume a square footing 5'x5', B = 5'

Average overburden pressure at 6.5 (Df + B/2) below ground level

$P_o = 105\text{pcf} \times 6.5' = 682\text{psf} = 0.34\text{ tsf}$

From Fig. 3, DM-7.1, Chapter 2, Dr = 77%
From Fig 7, DM-7.1, Chapter 3, $\phi = 37°$

From Fig 1, DM-7.2, Chapter 4, $N_q = 50$
From Fig. 1, DM-7.2, Chapter 4, $N_\gamma = 65$

$q_{ult} = 105\text{pcf}(4')(50) + 0.4(105)(5)(65)$

$= 34{,}650\text{ psf} \times 1\text{tsf}/2000\text{psf}$
$= 17.3\text{ tsf}$

Use a Factor of Safety of 3

Therefore Q allowable = 17.3tsf/3 = **5.8tsf**

TRC
TRC Environmental Corporation

SHEET NO. 4 OF 4
PROJECT NO.
DATE 4/22/93
BY
CHK'D

SUBJECT NETC NEWPORT - TANK FARM 5 IRM

CHECK FOR SETTLEMENT

From Fig. 6, DM-7.1, Chapter 5, $K_v = 240$ tcf

Assume a 5'x5' footing with $q = \frac{50\,T}{5' \times 5'} = 2$ tsf

$$\Delta H = \frac{4\,(2\text{ tsf})(5\text{ ft})^2}{240\text{ tcf}\,(5+1)^2} = 0.0231\text{ ft}$$

$$= 0.28\text{ inches}$$

USE 2 tsf design load

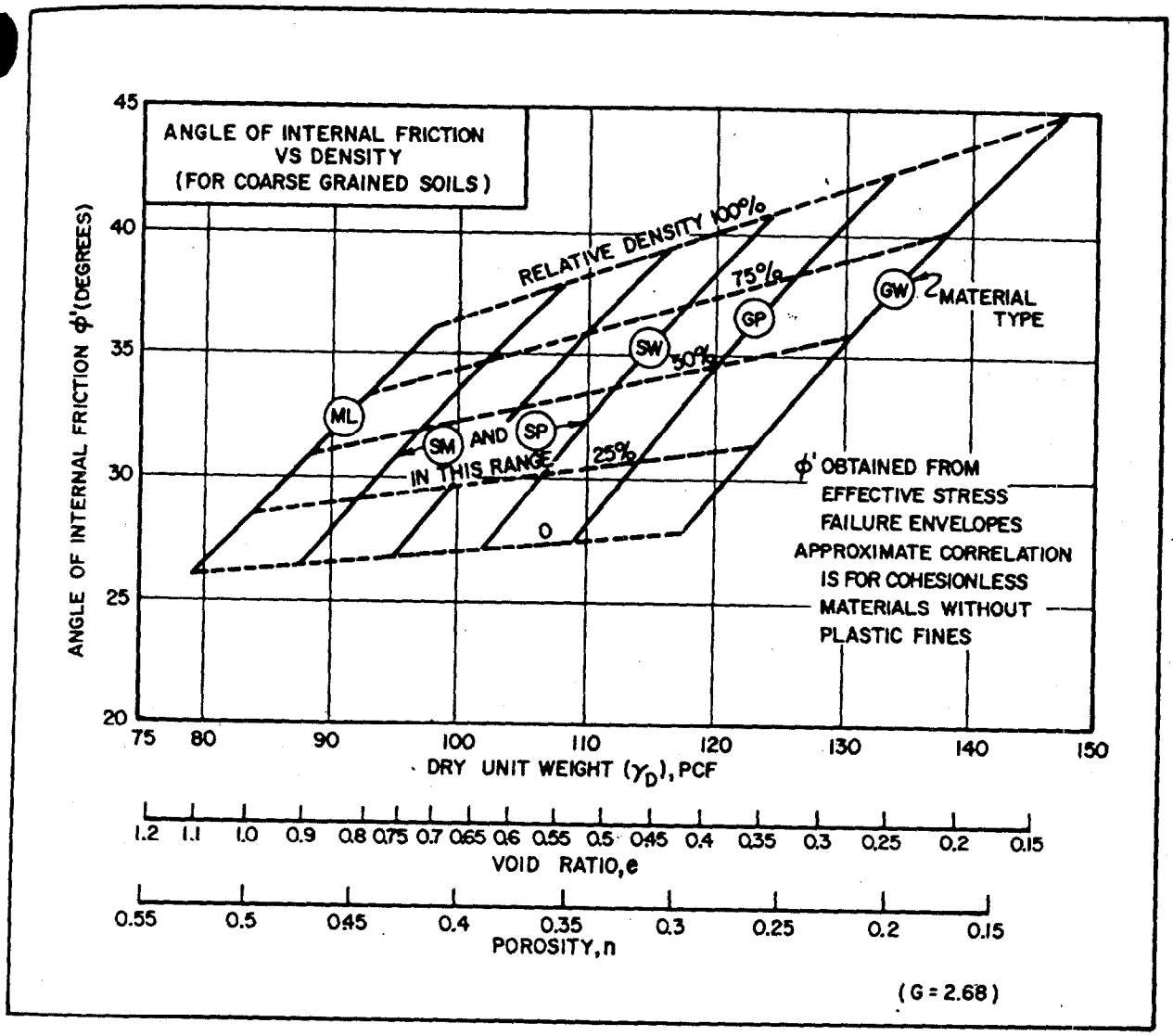


FIGURE 7
Correlations of Strength Characteristics for Granular Soils

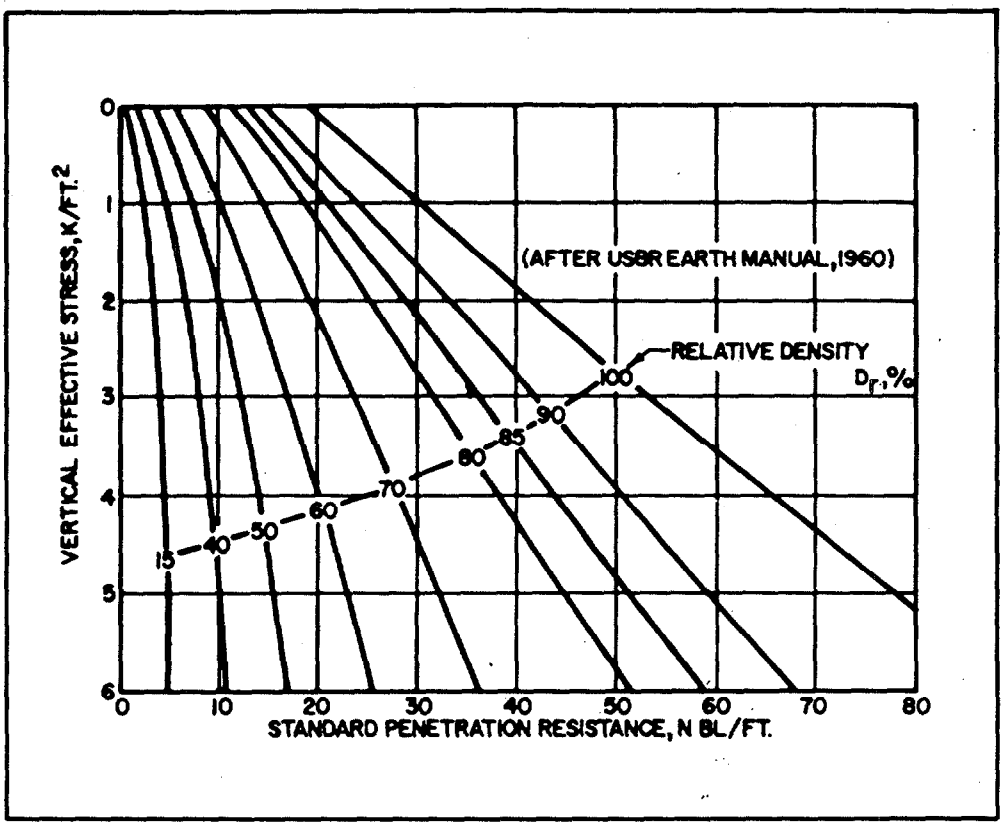


FIGURE 3
Correlations Between Relative Density and Standard Penetration Resistance in Accordance with Gibbs and Holtz

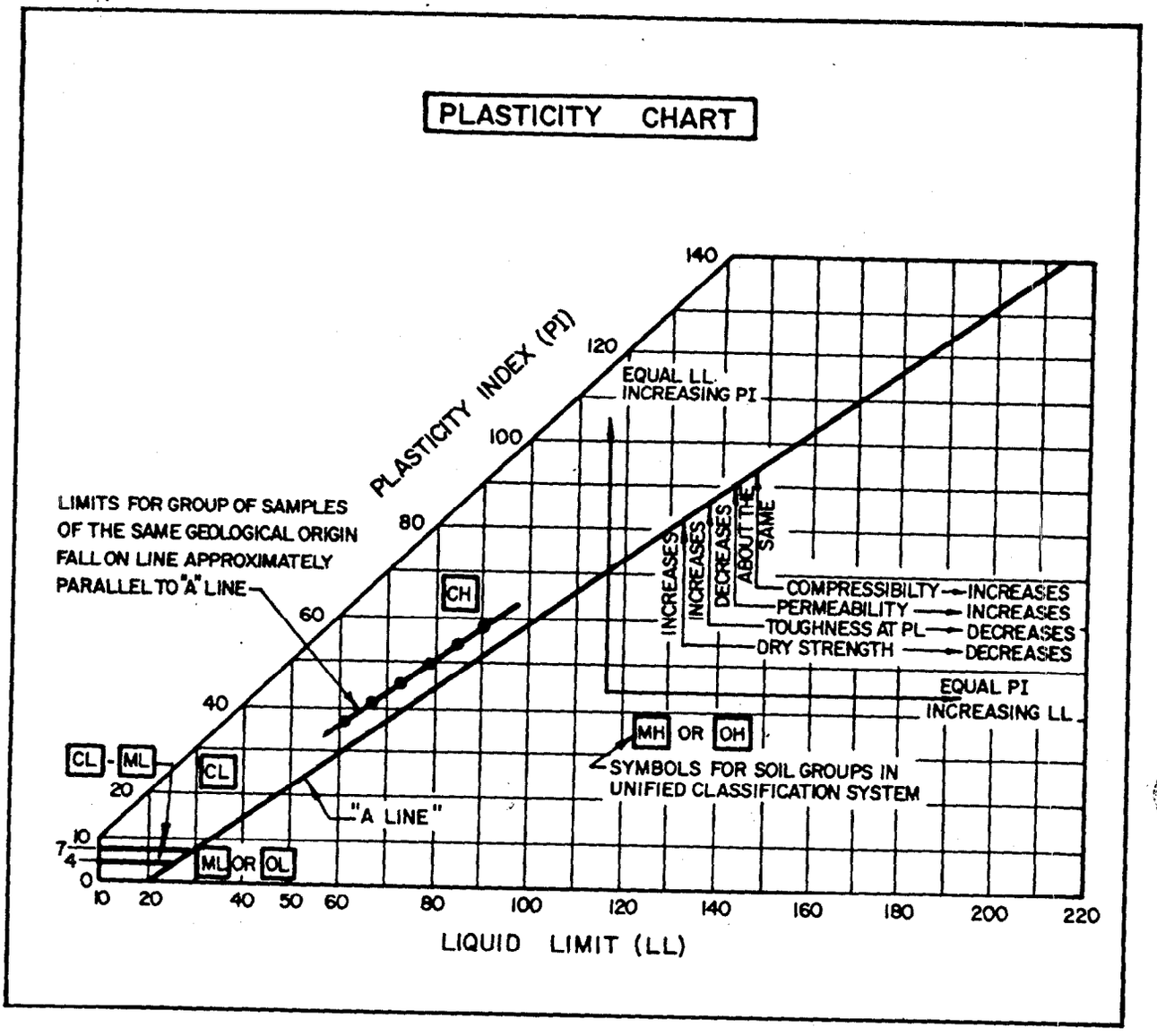
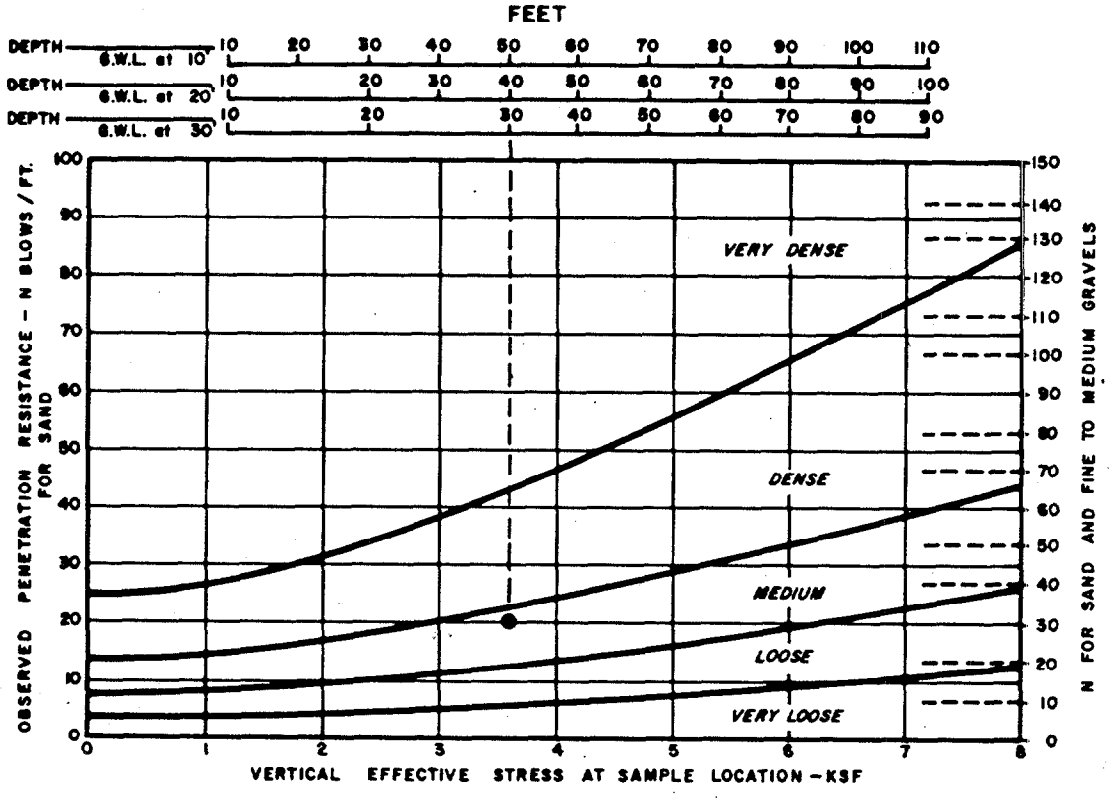


FIGURE 2
Utilization of Atterberg Plasticity Limits



Example:

Blow count in sand at a depth of 40 ft = 20
Depth of Groundwater Table = 20 ft
Compactness ~ medium

FIGURE 1
Estimated Compactness of Sand from Standard Penetration Test

* Material with 5 to 12 percent smaller than No. 200 sieve are borderline cases, designated: GW-GM, SW-SC, etc.

TABLE 3 (continued)
Unified Soil Classification System

Primary Divisions for Field and Laboratory Identification			Group Symbol	Typical Names	Laboratory Classification Criteria		Supplementary Criteria For Visual Identification
.....do....	.....do....	Sands with fines. (More than 12% of material smaller than No. 200 sieve size.)*	SM	Silty sands, sand-silt mixtures.	Atterberg limits below "A" line, or PI less than 4.	Atterberg limits above "A" line with PI between 4 and 7 is borderline case SM-SC.	Nonplastic fines or fines of low plasticity.
			SC	Clayey sands, sand-clay mixtures.	Atterberg limits above "A" line with PI greater than 7.		Plastic fines.

* Materials with 5 to 12 percent smaller than No. 200 sieve are borderline cases, designated: GW-GM, SW-SC, etc.

CONSTRUCTION TESTING & ENGINEERING, PC

P.O. Box 866 1764 Foxon Road North Branford, CT 06471
Office 203/481-8749 • Laboratory 203/458-9806 • FAX 203/488-5729

TRC ENVIRONMENTAL CORPORATION
5 WATERSIDE CRSG.
WINDSOR, CT 06095

PROJECT/REPORT # 93.002-TRCE/001

RE: PARTICLE SIZE ANALYSIS AND ORGANIC CONTENT

PROJECT FOR: NETC - TANK FARM #5
NEWPORT, RI

DEAR SIRS:
WE HAVE CONDUCTED TWO PARTICLE SIZE ANALYSIS AND TWO ORGANIC CONTENT ON FOUR JAR SAMPLES DELIVERED TO THIS OFFICE ON 3/4/93. THE RESULTS ARE AS FOLLOWS:

SAMPLE NO.	B-2 / S-2	B-3 / S-1
SIEVE SIZE	% BY WEIGHT PASSING	% BY WEIGHT PASSING
1/2"	88.6	86.4
3/8"	88.6	84.8
NO. 4	86.6	81.2
NO. 10	76.4	71.6
NO. 40	44.4	55.3
NO. 100	30.6	33.0
NO. 200	25.4	23.0

ORIGIN OF MATERIAL DELIVERED TO THIS OFFICE IN GLASS JARS

ASTM METHOD USED D 422 WASHED

DEVIATION FROM ASTM METHOD NONE

NOTE: 1. PARTICLES ARE ANGULAR AND SOFT
2. SEE GRADATION CURVE FOR MORE DETAILS

ORGANIC CONTENT:

SAMPLE #1 PLASTIC JAR
0-6" DEEP

ORGANIC MATTER = 3.9%
ASH CONTENT = 96.1%

FURNACE TEMPERATURE 440 C

MOISTURE CONTENT = 33% (Proportion of oven dried mass)

SAMPLE #3 PLASTIC JAR
0-6" DEEP

ORGANIC MATTER = 1.1%
ASH CONTENT = 98.9%

FURNACE TEMPERATURE 440 C

MOISTURE CONTENT = 11% (Proportion of oven dried mass)

ORIGIN OF MATERIAL DELIVERED TO THIS OFFICE IN PLASTIC JARS

ASTM METHOD USED D2974

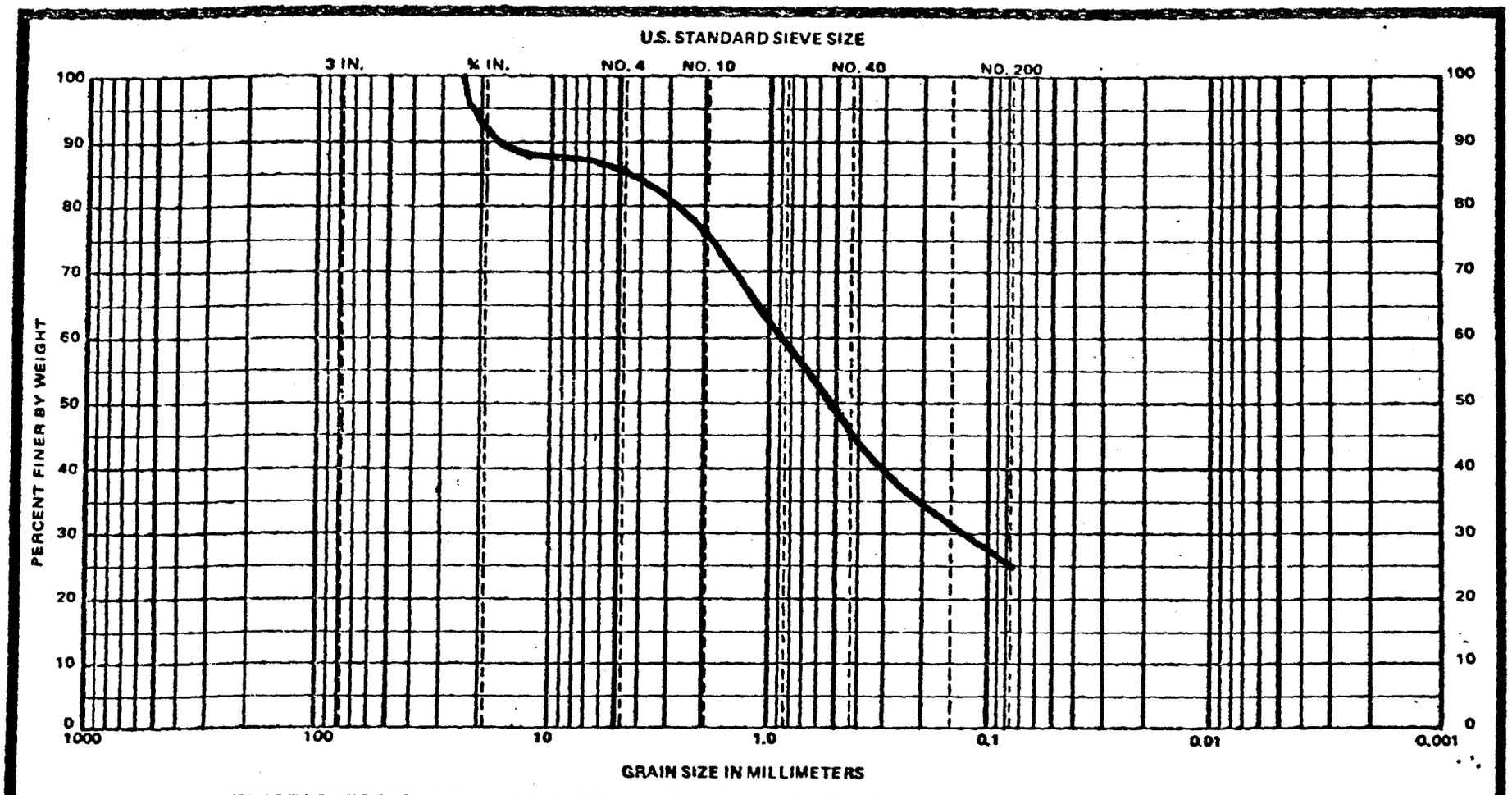
DEVIATION FROM ASTM METHOD NONE

SINCERELY
AUTHORIZED REPRESENTATIVE OF THE LABORATORY

STATE OF CONNECTICUT LAWRENCE J. MARCINIK LICENSED PROFESSIONAL ENGINEER

This report must not be reproduced except in full and with the approval of this testing laboratory, and this report relates only to the items tested.

CTE
P.O. Box 866
1764 Foxon Road
North Branford, CT 06471



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Course	Fine	Course	Medium	Fine	

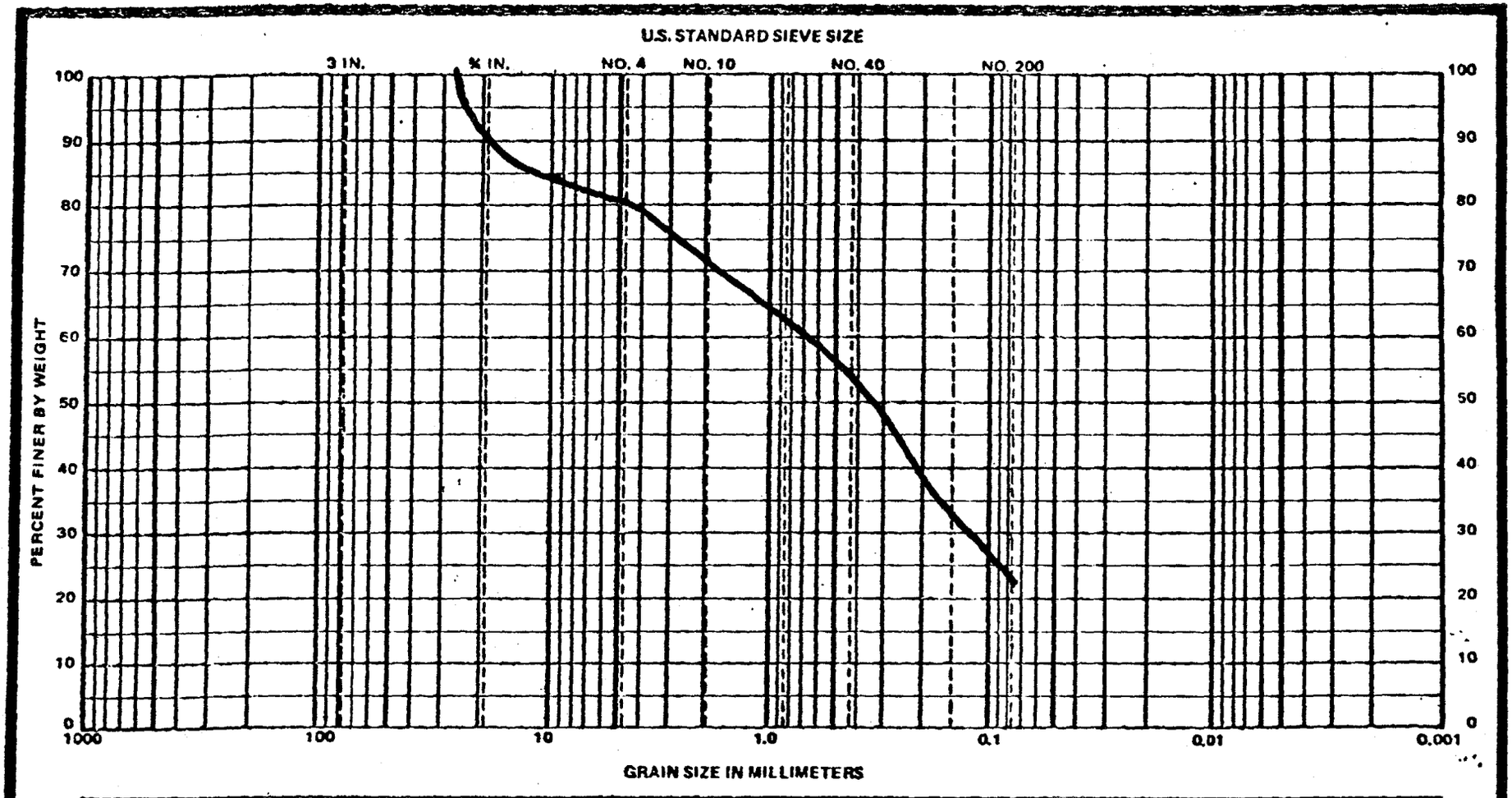
Sample No.	Elev. or Depth	Classification	Net W.C	LL	PL	PI	
S-2	8'-10'						

GRADATION CURVES

Project NETC - TANK FARM #5
NEWPORT, RI
Area
Boring No. B-2
Date 3-10-93 OF SIEVE ANALYSIS

C... TRUC... TES...G E...EERI...G, PC

P.O. Box 866
1764 Foxon Road
North Branford, CT 06471



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Course	Fine	Course	Medium	Fine	

Sample No.	Elev. or Depth	Classification	Nat W.C.	LL	PL	PI
S-1	5'-7'					

GRADATION CURVES

Project NETC - TANK FARM #5
NEWPORT, RI
Area
Boring No. B-3
Date 3-10-93 & SIEVE ANALYSIS

CONSTRUCTION TESTING & ENGINEERING, PC

P.O. Box 866 1764 Foxon Road North Branford, CT 06471
Office 203/481-8749 • Laboratory 203/458-9806 • FAX 203/488-5729

TRC P.O. # 23474
PROJECT/REPORT # 93.002-TRCE/002

TRC ENVIRONMENTAL CORPORATION
5 WATERSIDE CRSG.
WINDSOR, CT 06095

RE: LIQUID LIMIT, PLASTIC LIMIT AND PLASTIC INDEX

PROJECT FOR: NETC - TANK FARM #5
NEWPORT, RI

DEAR SIRS:
WE HAVE CONDUCTED TWO PLASTIC INDEX TESTS ON TWO JAR SAMPLES DELIVERED TO THIS OFFICE ON 4/8/93. THE RESULTS ARE AS FOLLOWS.

SAMPLE NO.	B-1/S-1	B-2/S-1
LIQUID LIMIT	24	22
PLASTIC LIMIT	17	18
PLASTICITY INDEX	7	4

ORIGIN OF MATERIAL DELIVERED TO THIS OFFICE IN GLASS JARS

ASTM METHOD USED D4318-84 1. AIR DRIED PREPARATION

DEVIATION FROM ASTM METHOD NONE

STATE OF CONNECTICUT
LAWRENCE J. MARCIK, JR.
No. 12285
LICENSED PROFESSIONAL ENGINEER

SINCERELY
AUTHORIZED REPRESENTATIVE OF CTE LABORATORY

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Professional Service Industries, Inc.
New Haven Testing Laboratory Division

REPORT ON CALIFORNIA BEARING RATIO ANALYSIS

TESTED FOR:

TRC Environmental Corporation
5 Waterside Crossing
Windsor, CT 06095

PROJECT:

NETC
Newport, RI
Purchase Order No. 023404

DATE: April 8, 1993

OUR REPORT NO.: 095-30083-0001

REMARKS: The following are the results of tests made on a sample of soil identified and submitted by the client on March 23, 1993.

TEST RESULTS

Max. Dry Density (p.c.f.)	132.0
Optimum Moisture (%)	8.0
Dry Density before Soaking (p.c.f.)	128.4
Moisture Content before Soaking (%)	5.2
Dry Density after Soaking (p.c.f.)	125.0
Moisture Content after Soaking (%)	11.9
Swell (%)	0.1
CBR @ 0.1"	16
CBR @ 0.2"	21

Respectfully submitted,
PSI/New Haven Testing Laboratory Division

Reports: 2-Ronald J. Nault, P.E.
b

D.L. MAHER CO.
DRILLING SERVICES
71 CONCORD STREET
N. READING, MA 01864
617/933-3210

SOIL BORING LOG

Boring / Well # B-1 Sheet 1 of 1
D.L. Maher Job # 92-
Driller [illegible] Helper [illegible]
Client TRC
Location Newport RI
Owner's Representative Ron Newlt
Date Started: 2/26/93 Date Finished: Same

	Casing	Sampler	Core Barrel
Type	HSA	Split spoon	
Size	4 1/4	2" x 24"	
Hammer wt.		140 lbs	
Hammer fall		30"	

Locus Map

Depth	Sample No.	Interval	Blows Per 6" on Sampler 0–6	6–12	12–18	18–24	Rec./RQD.	Soil Classification and Remarks	Lith. Log
	~~1~~	~~0~~	~~11~~	~~5~~	~~9~~	~~15~~			
	1	5-7	11	5	9	15		1) LT BRN/GREY silt, F-m sand,	
	2	10-12	22	17	36	51		2) Grey brn, F-m sand,	
	3	15-17	24	64	12/5"			3) GREY, Brn - F-m sand, some weathered shale	
	4	20-20.5	16/5"					4) weathered shale.	
								E.O.B. 20.0'	

Was boring converted to a well? ☐ Yes. (see attached well construction log) ☑ No. (see backfill info below)

Backfill Information

Intervals
Bent. Pellets _____ ft.
Sand _____ ft.
Volclay GRT _____ ft.
C/B GRT _____ ft.

Quantities

Sand	Bent. Pellets	Volclay Grout	Cement	Gran. Bentonite

Remarks Back Fill w/ cuttings

D.L. MAHER CO.

DRILLING SERVICES
71 CONCORD STREET
N. READING, MA 01864
617/933-3210

SOIL BORING LOG

Boring / Well # B-2 Sheet 1 of 1
D.L. Maher Job # 92-
Driller Jeff Quinn Helper Jim Moran
Client TRC
Location Newport, RI.
Owner's Representative Ron Nault
Date Started: 2/26/93 Date Finished: 2/26/93

Locus Map

	Casing	Sampler	Core Barrel
Type	HSA	S.S	
Size	4 1/4" ID	2"x24"	
Hammer wt.		140lbs	
Hammer fall		30"	

Depth	Sample No.	Interval	Blows Per 6" on Sampler 0–6	6–12	12–18	18–24	Rec./RQD.	Soil Classification and Remarks	Lith. Log
	1	3-5	10	15	22	15	24"	1) F-m sand brn, grey	
5	~~1~~	~~3-5~~	~~10~~	~~15~~	~~22~~	~~15~~			
	2	8-10	7	4	9	12	18"	2) F-m sand, weathered rock	
10	3	13-15	19	21	30	30	19"	3) Grey weathered rock Trace silt, Trace iron staining.	
15	4	18-20	72	100/1"	—	—		4) weathered rock refusal (split spoon)	
								E.O.B. 20.0	

Was boring converted to a well? ☐ Yes. (see attached well construction log) ☑ No. (see backfill info below)

Intervals

Bent. Pellets _____ ft.
Sand _____ ft.
Volclay GRT _____ ft.
C/B GRT _____ ft.

Backfill Information

Quantities

Sand	Bent. Pellets	Volclay Grout	Cement	Gran. Bentonite

Remarks Backfill - NATIVE cuttings

D.L. MAHER CO.

DRILLING SERVICES
71 CONCORD STREET
N. READING, MA 01864
617/933-3210

SOIL BORING LOG

Boring / Well # B-3 Sheet 1 of 1
D.L. Maher Job # 92-
Driller Jeff Quinn Helper Jim Moran
Client DeTRC
Location Newport, RI.
Owner's Representative Ron Nault
Date Started: 2/26/93 Date Finished: Same

Locus Map

	Casing	Sampler	Core Barrel
Type	4SH	S.S.	
Size	4" ID	2"x24"	
Hammer wt.		140 lbs	
Hammer fall		30"	

Depth	Sample No.	Interval	Blows Per 6" on Sampler 0–6	6–12	12–18	18–24	Rec./ RQD.	Soil Classification and Remarks	Lith. Log
5'	1	5-7	8	6	6	5	12"	1) Grey sand gravel w/cobbles.	
10'	2	10-12	18	20	50	FRACKED	14"	2) Weathered rock w/ lenses of silt, iron staining.	
15'	3	15-17	26	100/5"			8"	3) weathered rock.	
20'	4	20-22	100/3"				5"	4) weathered rock. E.O.B 20.0	

Was boring converted to a well? ☐ Yes. (see attached well construction log) ☑ No. (see backfill info below)

Intervals

Bent. Pellets _____ ft.
Sand _____ ft.
Volclay GRT _____ ft.
C/B GRT _____ ft.

Backfill Information

Quantities

Sand	Bent. Pellets	Volclay Grout	Cement	Gran. Bentonite

Remarks Backfill - native cuttings.

D.L. MAHER CO.

DRILLING SERVICES
71 CONCORD STREET
N. READING, MA 01864
617/933-3210

SOIL BORING LOG

Boring / Well # B-4 Sheet 1 of 1
D.L. Maher Job # 93
Driller K.K. Quinn Helper Jim Nolan
Client TRC
Location Newport, RI
Owner's Representative Ron Nault
Date Started: 2/26/93 Date Finished: same

Locus Map

	Casing	Sampler	Core Barrel
Type	HSA	S.S.	
Size	4¼" ID	2" X 24"	
Hammer wt.		140 lbs	
Hammer fall		30"	

Depth	Sample No.	Interval	Blows Per 6" on Sampler 0–6	6–12	12–18	18–24	Rec./ RQD.	Soil Classification and Remarks	Lith. Log
								1) Grey/brn Silty fine sand w/ pieces of shale Drilled thru live wire	
	1	3-5	10	16	20	22	17"		
								2) Weathered Rock. Brown, Grey. Quartz, Shale	
	2	8-10	16	19	16	27	18"		
								3) Weathered rock Quartz., Shale	
	3	13-15	13	30	45	30	22"		
								Weathered rock shale EOB 16.0	
	4	18-20	23	100/0"	—	—			

Was boring converted to a well? ☐ Yes. (see attached well construction log) ☑ No. (see backfill info below)

Intervals

Bent. Pellets _____ ft.
Sand _____ ft.
Volclay GRT _____ ft.
C/B GRT _____ ft.

Backfill Information

Quantities

Sand	Bent. Pellets	Volclay Grout	Cement	Gran. Bentonite

Remarks Cuttings

APPENDIX B

SUMMARY OF FIELD AQUIFER TESTING AND NUMERICAL MODELING

APPENDIX B
SUMMARY OF FIELD AQUIFER TESTING AND NUMERICAL MODELING
CONCEPTUAL REMEDIAL DESIGN - GROUND WATER RESTORATION
SITE 13 - TANK FARM FIVE
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RHODE ISLAND

INTRODUCTION

This report summarizes field aquifer testing and numerical computer modeling activities conducted for the purpose of designing an on-site ground water recovery and treatment system for NETC Newport Site 13, Tank Farm Five. These activities have been carried out in accordance with the Remedial Design Work Plan, Ground Water Treatment, Interim Remedial Action (TRC Environmental Corporation (TRC), January 1993), with the purpose of implementing a remedial system which will provide capture and treatment of the Tank Farm Five ground water contaminated at levels over ARARs/TBCs, as determined during the Phase I Remedial Investigation (TRC, November 1991).

FIELD AQUIFER TESTING

Aquifer slug tests and pump tests were conducted at the site to obtain weathered/fractured bedrock aquifer hydraulic data such as hydraulic conductivity, transmissivity and specific yield. The pump tests were also used to assess the response of the aquifer, in terms of radius of influence and drawdown, to pumping stresses. The results were then used in the recovery system design to determine the optimal number of extraction wells, well spacing and wellfield configuration for capturing the ground water contamination plume associated with Tank 53 at Tank Farm Five. A secondary goal was to determine the potential long-term sustainable yield from the proposed extraction wellfield. Information on the site-specific geology and hydrogeology is provided in Sections 3.4.2 and 3.5.2 of the Phase I RI Report.

Slug Tests

On July 25, 1990, as part of the Phase I RI field investigation, slug tests were performed at on-site monitoring wells, including MW-1S, MW-2S, MW-3S, MW-5S and MW-6S. The slug tests were conducted using a PVC rod as a slug. Prior to inserting the slug test rod into the well, a pressure transducer connected to a digital LCD readout was lowered into the well. The pressure transducer provides a continuous readout of the amount of water (feet) that is above the transducer. Once the water level had equilibrated after the slug test rod was lowered into the well, the slug rod was rapidly removed from the well and the transducer readings were recorded at specified intervals for approximately five minutes. The results of the slug tests, as presented in Appendix J and discussed in Section 3.5 of the Phase I RI Report, indicated a

hydraulic conductivity (K-value) range from 0.16 feet per day (ft/d) (MW-2S) to 0.25 ft/d (MW-6S), with an average K-value of 0.19 ft/d.

Pump Tests

Pumping and Observation Well Installation

From January 6, 1993 to January 12, 1993, for the purpose of conducting a 24-hour aquifer pump test, one pumping well (PW-1) and two observation wells (OW-1 and OW-2) were drilled and installed in the area of Phase I RI monitoring well MW-4 (Figure 1). MW-4 is located 20.5 feet to the northeast of PW-1, OW-1 is located 5.8 feet to the southeast of PW-1, and OW-2 is located 25.1 feet to the southeast of PW-1. OW-1, OW-2 and MW-4 thus form an orthogonal system of monitoring wells around PW-1.

The drilling and well installation activities were performed by the D.L. Maher Company, under the direction of TRC. The well boreholes were advanced using 4¼-inch I.D. hollow-stem augers, which create eight-inch-diameter boreholes. From the MW-4 boring log (Appendix G, Phase I RI Report), it was anticipated that the lithology would consist of an overburden of silt, weathered shale and fine sand to a depth of approximately 16 feet, where weathered shale bedrock would be encountered. The bedrock was expected to become more competent at a depth of approximately 30 feet. During the drilling of the first well installed, OW-1, two-inch split-spoon samples were collected every five feet until spoon refusal at 20.5 feet below grade. The samples indicated overburden materials consisting predominantly of silty fine to medium sand, silt and weathered shale. Weathered shale bedrock was encountered at approximately 15.5 feet, as revealed in the 15- to 17-foot spoon. Upon advancing the augers, bedrock was found to increase in competence at approximately 25 to 30 feet below grade. Auger refusal at OW-1 was encountered at 46.5 feet below grade. PW-1 and OW-2 were subsequently drilled with the 4¼-inch I.D. hollow-stem augers, with no split-spoon sampling. The PW-1 and OW-2 boreholes were advanced to the maximum design depth of 50.0 feet below grade with no auger refusal. All boring cuttings were placed in 55-gallon, open-top drums; each of the drums was labeled on its top and side with the site identification, contents and date, and was transported to Site 01, McAllister Point Landfill, for storage.

Upon advancing the augers to the final well depth, each well was constructed by lowering the well, constructed of twenty feet of two-inch I.D., Schedule 40, 20-slot PVC screen connected to a two-inch I.D., Schedule 40 PVC riser, inside the augers to the bottom of the borehole. The riser length was determined so as to provide a riser stickup of approximately two feet. Then, while slowly raising the augers, the annulus surrounding the well was filled with a filter pack consisting of #1 Morie well gravel, to a minimum height of 2.5 feet above the top of the screen. The augers were then completely removed from the borehole and two to three feet of bentonite chips were placed atop the filter pack; the bentonite was hydrated and allowed to swell for 24 hours prior to grouting. A grout mixture of 95% Portland cement and 5% bentonite clay grout was then mixed in a hopper and was tremied into the borehole to a depth

of approximately 2.5 feet below grade. A four-inch steel protective casing, five feet in total length and fitted with a locking cover, was then placed surrounding the riser and cemented into place with Portland cement reinforced with #1 Morie well gravel. Finally, the well identification was painted onto the protective casing. The well boring and construction logs are presented as Attachment A.

After drilling and well installation activities were completed, each of the new wells was developed. At each well, a length of dedicated polyethylene tubing, fitted with a foot check valve, was lowered to the bottom of the well. The tubing was connected to a Waterra inertial lift pump, which utilizes a piston action to bring the well water to the surface, while imparting a moderate surging effect. Each well was developed for two to three hours. Typically, at first the pumped water would be light grey, cloudy and silty; the silt content and degree of cloudiness decreased with time. The approximate average yields ranged from 0.65 gallons per minute (gpm) (OW-2) to 1.0 gpm (OW-1). All wells were pumped dry at least once during their development. The development water was directed into 55-gallon, open-top drums, which were then labeled and transported to McAllister Point Landfill for storage.

Pump Tests - General Procedure

Constant-rate pump tests were performed on PW-1 on February 11, 1993 and on March 17-18, 1993. A Grundfos Redi-Flo2 two-inch electric submersible pump was used to pump PW-1. One-half-inch polyethylene tubing was clamped to the flow outlet atop the pump and the pump electric power cord was taped to the tubing, and the pump was lowered to the bottom of PW-1. The tubing emerging from the wellhead was fitted with a gate valve (to prevent return flow down the tubing during recovery), a spigot, and a 5/8-inch totalizing flow meter. Additional tubing was then added as necessary to direct the flow from PW-1 approximately 450 feet southeast to Tank 52, where the tubing was directed into the ventilation shaft of the tank. Power to the pump was provided by a 1500-watt portable generator, through a Grundfos BMI/MP1 pump converter box, where pump speed could be electronically controlled.

After installing the pump, pressure transducers were placed in wells PW-1, OW-1, OW-2 and MW-4, and were connected to an Enviro-Labs EL-200 electronic data logger to provide digital water level readouts and data recording. Depth-to-water measurements were periodically made at each of the four monitored wells, to provide water level elevation correspondence to the height-of-water readings recorded from the transducers. For at least 12 hours prior to the initiation of each pump test, water level measurements were recorded at each well every 15 minutes, for the determination of any trends in the pre-pumping water levels (i.e., upward, downward or fluctuating) that could be incorporated into the pump test data interpretations.

Prior to the initiation of Pump Test 1, a short-duration step-drawdown test was performed on PW-1 on February 10, 1993 to determine the optimal pumping rate for maximizing drawdown without drying the well. The step-drawdown test involves increasing the pumpage from the well in successive steps or stages while recording the changes in water level in the pumped well. An initial pumping rate of 0.5 gpm was selected for the first step; this rate

resulted in approximately 8.5 feet of drawdown in the well, after one hour of pumping. The flow rate was subsequently increased to 0.75 gpm; this rate caused the water level to fall below the transducer, located approximately 2 feet above the pump, after 45 minutes. The flow rate was then reduced to 0.45 gpm, where the water level stabilized at approximately 21 feet of drawdown. From this information, a flow rate of 0.35 gpm was proposed for the pump test.

In preparing for each pump test, the data logger was programmed with a sampling sequence that would allow data to be collected at intervals that would be initially short (i.e., every second) and would gradually lengthen, to a maximum interval of 10 minutes. For the beginning of the recovery period, the logger would be programmed to start a new recording event, to log the recovery data under the same interval schedule as for the pump test.

Pump Test 1

On February 9 and 10, 1993, two attempts were made at performing a 24-hour pump test of PW-1. During these two attempts, pump failure and water freezing in the effluent line after the step-drawdown test necessitated postponement of the pump test. On February 11, 1993, a nine-hour pump test of PW-1 was performed, with an average pumping rate of 0.35 gpm. In accordance with the Work Plan, the test was intended to be conducted for 24 hours or until a steady state had been reached. However, it was necessary to terminate the test at nine hours, when a voltage surge caused the pump converter box to shut off current to the pump. When the pump stopped, the water in the effluent line froze in several locations along the line. It was then decided to postpone further testing until weather conditions permitted.

During Pump Test 1, two rounds of effluent samples were collected for laboratory analysis. These samples were collected to provide additional ground water quality information near the leading edge of the contaminant plume and to provide additional information to be used in the treatment system design. The first sample (TF5-PW1-01-021193) was collected approximately 2.5 hours into the pump test, and the second sample (TF5-PW1-02-021193) was collected approximately one half-hour after the test was terminated. The samples were collected at the in-line spigot at the wellhead; water from the spigot was collected directly into the sample jars. Samples were collected for the following analyses:

- Volatile organic compounds (VOCs);
- Base neutral/acid extractables (BNAs);
- Pesticides/PCBs;
- Cyanide;
- Hardness;
- Total dissolved solids (TDS), total suspended solids (TSS), pH and alkalinity; and
- Metals - iron and manganese.

The effluent samples were shipped to Weston Analytics in Lionville, Pennsylvania for analysis. The analytical results are presented in Table 1.

In addition to the samples for laboratory analysis, two rounds of effluent samples were collected for field parameter screening. The first sample was collected at approximately 6.5 hours into the pump test, and the second sample was collected approximately one hour after the termination of the test. The samples were measured for temperature, conductivity and pH. The Yellow Springs Instruments Model 33 S-C-T meter was used to measure temperature and conductivity, the Orion Research Ionalyzer Model 407A was used to measure pH, and the Orion Research Portable Meter Model SA230 was used to measure temperature and pH. The field parameter screening results are presented in Table 2.

Pump Test 2

On March 17 and 18, a 24-hour pump test was performed, with an average pumping rate of 0.34 gpm. Following completion of the pump test, the pump was shut off and non-pumping, recovery measurements were collected for a three-hour period. The recovery monitoring was terminated after three hours because the water levels in all of the wells had recovered either to or above their original pre-pumping levels, and the water levels were at near-stasis.

Pump Test Analyses

The pump test data were analyzed to determine aquifer hydraulic characteristics using AQUIX123™ (Interpex Limited, 1988), an interactive analytical computer program. The analytical method used was the curve-fitting method developed by Neuman (1975) for completely or partially penetrating wells in an anisotropic unconfined aquifer with delayed gravity response.

The background water level measurements taken prior to each of the pump tests did not show a significant pre-pumping trend of upward or downward change in the water level at any of the monitored wells. However, prior to and for approximately the first 10.5 hours of Pump Test 2, a light to heavy rain fell on the site. Snow and freezing rain fell on the site from 10.5 hours until approximately 16.5 hours into the pump test. The effect of precipitation recharge to the ground water was observed both during the late stages of the pump test, where water levels rose despite maintaining a constant 0.34 gpm flow rate, and in the recovery period, where the water levels rebounded to levels up to 0.15 foot (OW-1) above the pre-pumping levels. For the purpose of preparing the data for analysis, a "background" correction factor of 0.15 foot per 24 hours was applied to the Pump Test 2 pumping and recovery data to compensate for the precipitation recharge impact.

As summarized in Table 3 and in Attachment B, the analysis of Pump Test 1 yielded K-values ranging from 0.30 ft/d (OW-1) to 0.77 ft/d (MW-4), for an average K-value of 0.55 ft/d. The Pump Test 2 pumping analysis produced K-values ranging from 0.14 ft/d (OW-1) to 5.95 ft/d (MW-4), for an average K-value of 2.23 ft/d. The Pump Test 2 recovery analysis yielded K-values ranging from 0.18 ft/d (OW-1) to 2.27 ft/d (MW-4), for an average K-value of 1.09 ft/d. The highest K-value was consistently derived from the MW-4 data, followed by OW-2 and OW-1. It is noted that MW-4 is screened from 16 to 31 feet below grade, approximately 20 feet above the other three wells. In addition, MW-4 is located perpendicular to OW-1 and OW-2

with respect to PW-1. These factors may have resulted in differences between MW-4 and the other two observation wells in responding to the pumping at PW-1. After excluding the 2.27 ft/d and 5.95 ft/d MW-4 K-values as high, the average of the remaining K-values determined from the two pump tests was 0.48 ft/d. From this, a K-value of 0.50 ft/d was selected for initial hydraulic parameter input to the remedial design computer model.

NUMERICAL COMPUTER MODELING

Objectives

The estimated area of ground water at Tank Farm Five contaminated at levels in excess of ARARs/TBCs is shown in Figure 2, and is presumed to constitute a plume extending roughly northward from Tank 53 to the MW-4 area. Using the aquifer hydraulic data collected during both the Phase I RI and the subsequent pump tests, numerical computer modeling was conducted for the purpose of designing an on-site ground water pump and treat remedial system that would provide capture and treatment of the contaminated ground water. The goal was to provide capture of ground water both close to the apparent contaminant source at Tank 53, as well as at the presumed downgradient edge of the plume, in the MW-4 area.

Methodology

Model Setup and Initial Input

FLOWPATH™ (Waterloo Hydrogeologic Software, 1992), a two-dimensional numerical ground water flow and pathlines simulation model, was used in the ground water recovery system design. FLOWPATH assumes the following: 1) the pumping wells fully penetrate the model layer, and no water is stored in the well bores; 2) prior to pumping, the regional piezometric surface can be either horizontal or sloping; and 3) water is released instantaneously from storage by the compaction of the aquifer matrix and by the expansion of the water itself. Additionally, it was assumed that the aquifer was a homogeneous, isotropic medium and that steady state conditions were to be simulated.

The model input parameters and results are summarized in Table 4, and the resulting graphical output is presented in Figures 3 through 7. The initial aquifer K-value was set at 0.50 ft/d and the aquifer porosity was set at 0.05 (5%), the average typical value for shale (Freeze and Cherry (1979) and Driscoll (1986)). The average aquifer saturated thickness was set at 30 feet; this represents both the saturated thickness at PW-1, OW-1 and OW-2 during the pump tests, as well as the minimum nonpumping saturated thickness proposed for the recovery wells. The aquifer was modeled as unconfined, where a portion of the water stored in the aquifer is released by dewatering of the aquifer, and transmissivity is a product of the hydraulic conductivity and saturated thickness.

The area encompassed by the model grid is shown in Figure 3. The grid was aligned to parallel the roughly north-south ground water flow direction in the modeled area. The grid measured 600 feet (east-west) by 700 feet (north-south), and was configured with 36 rows and 34 columns with variable nodal spacing.

Model Calibration

For initial steady-state (non-stressed) calibration, initial head matrices, determined from the average ground water contours for July 17, 1990 and September 20, 1990 (Figures 1 and 2, Site 13 - Tank Farm Five, Phase I RI Report), were input to the model. The average horizontal hydraulic gradient in the area for these two monitoring events was 0.027 ft/ft. As the modeled area of the aquifer is not known to be bounded on any side by an impermeable hydraulic boundary, constant-head boundaries were placed on the grid surrounding the modeled region to establish flow through the model. After each model run was conducted, the aquifer hydraulic conductivity value and/or the constant head boundary values were adjusted as necessary. Using this technique, a satisfactory calibration was achieved for the average non-pumping ground water contours for July 17, 1990 and September 20, 1990. Figure 4 shows the results of the steady-state calibration process.

Model Verification

Following the steady-state calibration, the model was verified to stressed bedrock aquifer conditions imposed by the pumping of PW-1 during Pump Test 2. This process was completed by calibrating the model to the ground water levels observed during the late stage of the pump test at observation wells OW-1 and OW-2. The model verification output is presented in Figure 5. The node representing PW-1 was designated a negative flux boundary, and the model was run under steady-state conditions. The K-value was further adjusted to provide agreement between the modeled contours and the water levels measured at the observation wells during the pump test. The adjusted K-value, 1.0 ft/d, was then input to the steady-state calibration simulation, to verify its suitability to both non-stressed and stressed aquifer conditions.

Extraction Wellfield Simulations

After completing the model calibration and verification steps, several extraction wellfield configuration options were evaluated with respect to the goal of capturing ground water flow from areas that were found in the Phase I RI to exhibit contamination above ARARs/TBCs. It was assumed that a series of extraction wells would be located in the area of the presumed downgradient edge of the plume, in the MW-4 area. An additional goal was to provide capture of ground water just downgradient from the apparent ground water contamination source at Tank 53, to minimize the potential for future mechanical dispersion and chemical diffusion of contaminants migrating from the tank area with the bulk ground water flow.

For each of the extraction scenarios, numerous evaluations were made to determine the optimum combination of extraction rates and well locations for that scenario. The resultant

ground water hydraulic head distributions and corresponding calculated pathlines and capture zones were inspected to ensure that adequate capture was accomplished across the estimated area of contaminated ground water. Based on the low yield of PW-1, it was assumed that, taking into account well interference effects, the system design would incorporate an average extraction rate of 0.25 gpm (360 gallons per day (gpd)) per well. This was done to ensure that the recovery wellfield would be of sufficient density and areal extent so that capture of the contaminated zone would be accomplished even at this low flow rate.

For the purposes of performing a sensitivity analysis and of simulating the response of the system to the potential presence of zones of higher hydraulic conductivity, the model K-value was raised to 5.0 ft/d. The recovery well extraction rates were then increased until capture of the contaminated ground water was shown. Additional sensitivity analyses were conducted to evaluate the effect on the model output of different values for porosity and aquifer thickness. In general, a higher porosity or a larger aquifer thickness would require higher pumping rates to obtain an adequate capture zone.

An extraction well's zone of influence includes the entire area in which drawdown occurs in response to the ground water sink created by the well. Capture zones are limited to those portions of the flow regime where the water table/piezometric surface can be seen to be sloped toward the extraction well, so that ground water, flowing perpendicular to the piezometric contours, would likely be drawn into the well. Therefore, the extraction well's zone of capture does not include the entire zone of influence for the well.

Model Results/Recommended Recovery Wellfield Design

The results of the extraction wellfield modeling indicated that a network of 13 extraction wells, shown in Figure 6, would provide capture of the area of ground water contamination between Tank 53 and the MW-4 area. Eight of these wells would lie in a line stretching southwest from approximately the MW-4 location to the Fire Fighting Training Center entrance road. These wells would have a center-to-center spacing of 22.5 feet, for a total line length of 157.5 feet. The remaining five wells would lie in an east-west line approximately 60 feet downgradient from Tank 53, adjacent to monitoring well MW-8. These wells would have a center-to-center spacing of 10.0 feet, for a total line length of 40.0 feet. The resultant particle pathlines and wellfield capture zones are shown in Figure 7. At its widest point in the modeled area, the capture zone would measure approximately 440 feet across; the downgradient extent of capture would lie approximately 35 feet beyond the downgradient line of recovery wells.

The results of the sensitivity/system analysis indicated that an increase of hydraulic conductivity to 5.0 ft/d would result in a directly proportional increase in the extraction rate necessary to establish adequate capture. Therefore, operating in a saturated medium with a 5.0 ft/d K-value, each well would extract at 1.25 gpm (1,800 gpd), for a total system flow rate of 16.25 gpm (23,400 gpd).

The recovery wells should be designed to provide adequate available drawdown in the event that the wells have to be pumped at higher than the design rate to provide capture. As an additional modeled test of system response to varying pumping stresses, the K-value was entered as 3.0 ft/d and the pumping rate was raised to 2.0 gpm (2,880 gpd) per well (26.0 gpm (37,440 gpd) total). The maximum drawdown measured in this scenario was 20.3 feet. To provide adequate available drawdown in the event that the wells have to be pumped at higher than the design rates, it is recommended that each well be designed to provide a non-pumping water column of 70 feet. This would translate to a design well depth of 100 feet in the downgradient line of wells near MW-4 and a design depth of 110 feet in the upgradient line of wells adjacent to MW-8. Table 5 summarizes the design specifications of the recovery wells proposed for Tank Farm Five.

TABLES

TABLE 1
VOLATILE ORGANIC COMPOUND (VOC) DATA
TANK FARM FIVE REMEDIAL DESIGN PUMP TEST, 2/11/93
PW1 EFFLUENT

SAMPLE IDENTIFICATION DATE COLLECTED	PW1–01 2/11/93	PW1–02 2/11/93
VOLATILE ORGANICS (PPB)		
Chloromethane		
Bromomethane		
Vinyl Chloride		
Chloroethane		
Methylene Chloride		
Acetone		
Carbon Disulfide		
1,1–Dichloroethene		
1,1–Dichloroethane	1 J	1 J
1,2–Dichloroethene (Total)	5 J	5 J
Chloroform	6 J	6 J
1,2–Dichloroethane		
2–Butanone		
1,1,1–Trichloroethane	3 J	3 J
Carbon Tetrachloride		
Bromodichloromethane		
1,2–Dichloropropane		
cis–1,3–Dichloropropene		
Trichloroethene	3 J	4 J
Dibromochloromethane		
1,1,2–Trichloroethane		
Benzene		
trans–1,3–Dichloropropene		
Bromoform		
4–Methyl–2–pentanone		
2–Hexanone		
Tetrachloroethene		
1,1,2,2–Tetrachloroethane		
Toluene	2 J	4 J
Chlorobenzene		
Ethyl Benzene		
Styrene		
Total Xylenes		
TOTAL VOLATILE ORGANICS	20	23

TABLE 1, CONTINUED
SEMIVOLATILE ORGANIC COMPOUND (BNA) DATA
TANK FARM FIVE REMEDIAL DESIGN PUMP TEST, 2/11/93
PW1 EFFLUENT

SAMPLE IDENTIFICATION	PW1-01	PW1-02
DATE COLLECTED	2/11/93	2/11/93
BNA COMPOUNDS (PPB)		
Phenol		
bis(2-Chloroethyl)ether		
2-Chlorophenol		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
1,2-Dichlorobenzene		
2-Methylphenol		
2,2'-oxybis(2-chloropropane)		
4-Methylphenol		
N-Nitroso-di-n-propylamine		
Hexachloroethane		
Nitrobenzene		
Isophorone		
2-Nitrophenol		
2,4-Dimethylphenol		
bis(2-Chloroethoxy)methane		
2,4-Dichlorophenol		
1,2,4-Trichlorobenzene		
Napthalene		
4-Chloroaniline		
Hexachlorocyclopentadiene		
2,4,6-Trichlorophenol		
2,4,5-Trichlorophenol		
2-Chloronaphthalene		
2-Nitroaniline		
Dimethylnapthalene		
Acenaphthylene		
2,6-Dinitrotoluene		
3-Nitroaniline		
Acenaphthene		
2,4-Dinitrophenol		
4-Nitrophenol		
Dibenzofuran		
2,4-Dinitrotoluene		
Diethylphthalate		
4-Chlorophenyl-phenylether		
Fluorene		
4-Nitroaniline		
4,6-Dinitro-2-methylpenol		
N-Nitrosodipheylamine		
4-Bromophenyl-phenylether		
Hexachlorobenzene		
Pentachlorophenol		
Phenanthrene		
Carbazole		
Di-n-butylphthalate		
Flouranthene		
Pyrene		
Butylbenzylphthalate		
3,3'-Dichlorobenzidine		
Benzo(a)anthracene		
Chrysene		
bis(2-Ethylhexyl)phthalate	1 J	
Di-n-octyl phthalate		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzo(a)pyrene		
Ideno(1,2,3-cd)pyrene		
Dibenz(a,h)anthracene		
Benzo(g,h,i)perylene		

TABLE 1, CONTINUED
TCL PESTICIDE/PCB AND INORGANIC DATA
TANK FARM FIVE REMEDIAL DESIGN PUMP TEST, 2/11/93
PW1 EFFLUENT

SAMPLE IDENTIFICATION DATE COLLECTED	PW1–01 2/11/93	PW1–02 2/11/93
PESTICIDES/PCBs		
Alpha–BHC		
Beta–BHC		
Delta–BHC		
Gamma–BHC (Lindane)		
Heptachlor		
Aldrin		
Heptachlor Epoxide		
Endosulfan I		
Dieldrin		
4,4'–DDE		
Endrin		
Endosulfan II		
4,4'–DDD		
Endosulfan sulfate		
4,4'–DDT		
Methoxychlor		
Endrin ketone		
Endrin aldehyde		
Alpha–Chlordane		
Gamma–Chlordane		
Toxaphene		
Aroclor–1016		
Aroclor–1221		
Aroclor–1232		
Aroclor–1242		
Aroclor–1248		
Aroclor–1254		
Aroclor–1260		
INORGANICS (PPB)		
Iron	886	944
Manganese	190	171
INORGANICS (PPM)		
Alkalinity	120	120
Cyanide, Total		
Hardness	164	44.0
pH	6.2	6.3
Total Dissolved Solids	235	217
Total Suspended Solids	15.0	28.0

TABLE 2
PUMP TEST 1 FIELD PARAMETER SCREENING RESULTS
CONCEPTUAL REMEDIAL DESIGN – GROUND WATER RESTORATION
SITE 13 – TANK FARM FIVE
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RHODE ISLAND

			YSI MODEL 33 S–C–T METER		ORION RESEARCH PORTABLE METER		ORION RESEARCH IONALYZER	pH TESTR2 PEN
SAMPLE	DATE	TIME	TEMPERATURE (°C)	CONDUCTIVITY (umhos)	TEMPERATURE (°C)	pH	pH	pH
1	02/11/93	1730	9.5	270	9.5	6.26	5.8	6.4
2	02/11/93	2100	10.0	270	9.5	6.38	6.4	6.4

TABLE 3
AQUIFER HYDRAULIC TEST ANALYSIS RESULTS
CONCEPTUAL REMEDIAL DESIGN – GROUND WATER RESTORATION
SITE 13 – TANK FARM FIVE
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RHODE ISLAND

HYDRAULIC TEST, DATE	WELL	K–VALUE (ft/d)	AVERAGE K–VALUE (ft/d)	NOTES
SLUG TESTS, 07/25/90	MW–1S	0.18		ANALYSIS METHOD FOR SLUG TEST:
– Appendix J, Phase I RI Report	MW–2S	0.16		Bouwer and Rice (1976), using SLUGIX
(TRC, November 1991)	MW–3S	0.21		(Interpex Limited, 1988)
	MW–5S	0.17		
	MW–6S	0.25	0.19	
PUMP TEST, 02/11/93	OW–1	0.30		ANALYSIS METHOD FOR PUMP TESTS:
	OW–2	0.57		Newman (1975), using AQUIX123
	MW–4	0.77	0.55	(Interpex Limited, 1988)
PUMP TEST, 03/17/93–03/18/93: PUMPING	OW–1	0.14		
	OW–2	0.59		
	MW–4	5.95	2.23	
RECOVERY	OW–1	0.18		
	OW–2	0.83		
	MW–4	2.27	1.09	

TABLE 4
FLOWPATH MODEL INPUT PARAMETERS AND RESULTS
CONCEPTUAL REMEDIAL DESIGN – GROUND WATER RESTORATION
SITE 13 – TANK FARM FIVE
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RHODE ISLAND

K–VALUE SELECTED FROM AQUIFER HYDRAULIC TEST ANALYSES FOR INITIAL MODEL INPUT:	0.50 ft/d
NUMERICAL MODEL FOR SIMULATION OF AQUIFER AND RECOVERY SYSTEM:	FLOWPATH Ver. 4 (Waterloo Hydrogeologic Software, 1992) Assumptions: Isotropic medium, steady state conditions
INITIAL MODEL INPUT:	K = 0.50 ft/d Aquifer Porosity = 0.05 (Average typical value for shale (Freeze and Cherry, 1979 and Driscoll, 1986)) Aquifer Saturated Thickness = 30 ft
MODEL CALIBRATION: FIELD DATA:	Average Estimated Water Table Contours, 07/17/90 and 09/20/90 (Figures 1 and 2, Site 13 – Tank Farm Five, Phase I RI Report (TRC, November 1991) Average Horizontal Hydraulic Gradient = 0.027 ft/ft
MODEL VERIFICATION: FIELD DATA:	Maximum Compensated Drawdown at observation wells OW–1 and OW–2 PW–1 Pump Test, 03/17/93–03/18/93
VERIFICATION RESULTS:	<3% deviation from actual Maximum Compensated Drawdown at OW–1 and OW–2 Adjusted K = 1.0 ft/d
RECOVERY WELLFIELD SIMULATION RESULTS AND RECOMMENDED WELLFIELD DESIGN:	Number of Recovery Wells = 13 (Five just downgradient of Tank 53, Eight in MW–4 area) Well Spacing = 10 feet just downgradient of Tank 53, 22.5 feet in MW–4 area Pumping Rates = 0.25 gpm minimum per recovery well, 3.25 gpm minimum total Width of Capture Zone = 440 feet at widest (upgradient) point in modeled area at 25 gpm/well Downgradient Extent of Capture Zone = 35 feet beyond line of recovery wells in MW–4 area at 25 gpm/well.

TABLE 5
SUMMARY OF DESIGN SPECIFICATIONS FOR PROPOSED RECOVERY WELLS
CONCEPTUAL REMEDIAL DESIGN – GROUND WATER RESTORATION
SITE 13 – TANK FARM FIVE
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RHODE ISLAND

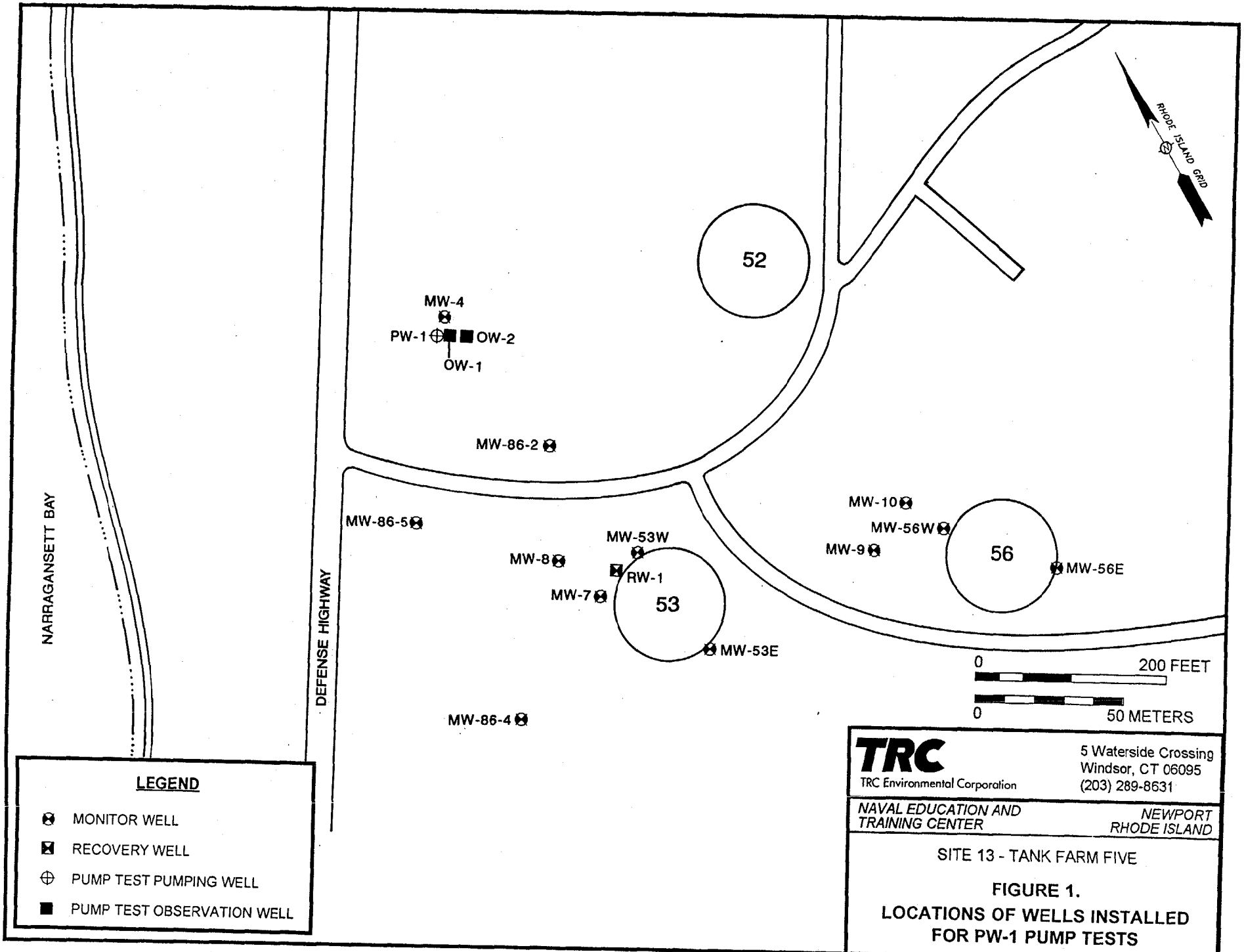
DOWNGRADIENT SERIES OF WELLS (EW–1 THROUGH EW–8):

TOTAL DEPTH:	100 FEET
BOREHOLE DIAMETER:	12 INCHES
SCREENED INTERVAL:	20 TO 100 FEET BELOW GRADE
SCREEN:	4–INCH STAINLESS STEEL, CONTINUOUS–SLOT, 10–SLOT
RISER:	4–INCH STAINLESS STEEL
PUMP SET DEPTH:	95 FEET BELOW GRADE

UPGRADIENT SERIES OF WELLS (EW–9 THROUGH EW–13):

TOTAL DEPTH:	110 FEET
BOREHOLE DIAMETER:	12 INCHES
SCREENED INTERVAL:	20 TO 110 FEET BELOW GRADE
SCREEN:	4–INCH STAINLESS STEEL, CONTINUOUS–SLOT, 10–SLOT
RISER:	4–INCH STAINLESS STEEL
PUMP SET DEPTH:	105 FEET BELOW GRADE

FIGURES



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SITE 13 - TANK FARM FIVE

FIGURE 1.
LOCATIONS OF WELLS INSTALLED FOR PW-1 PUMP TESTS

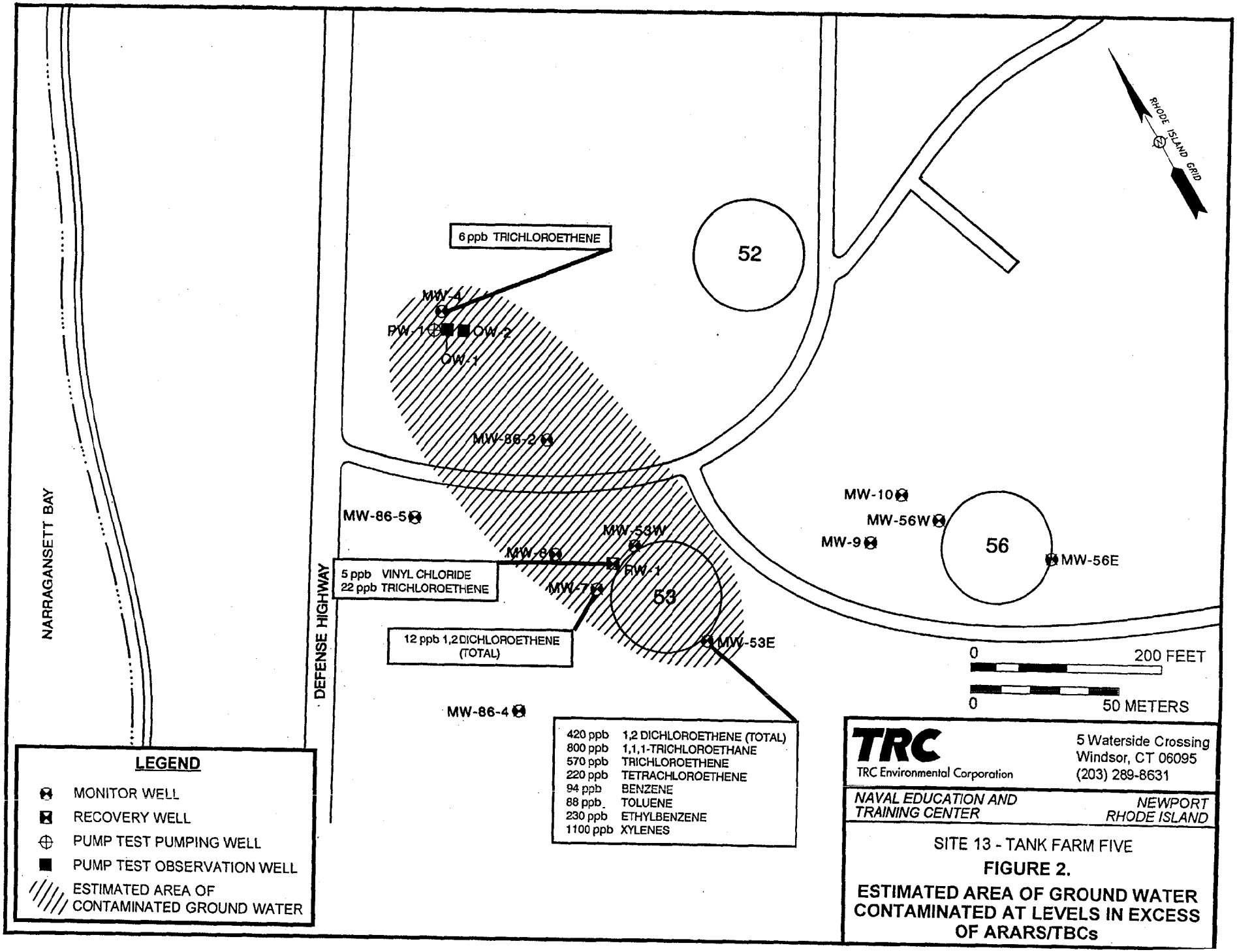

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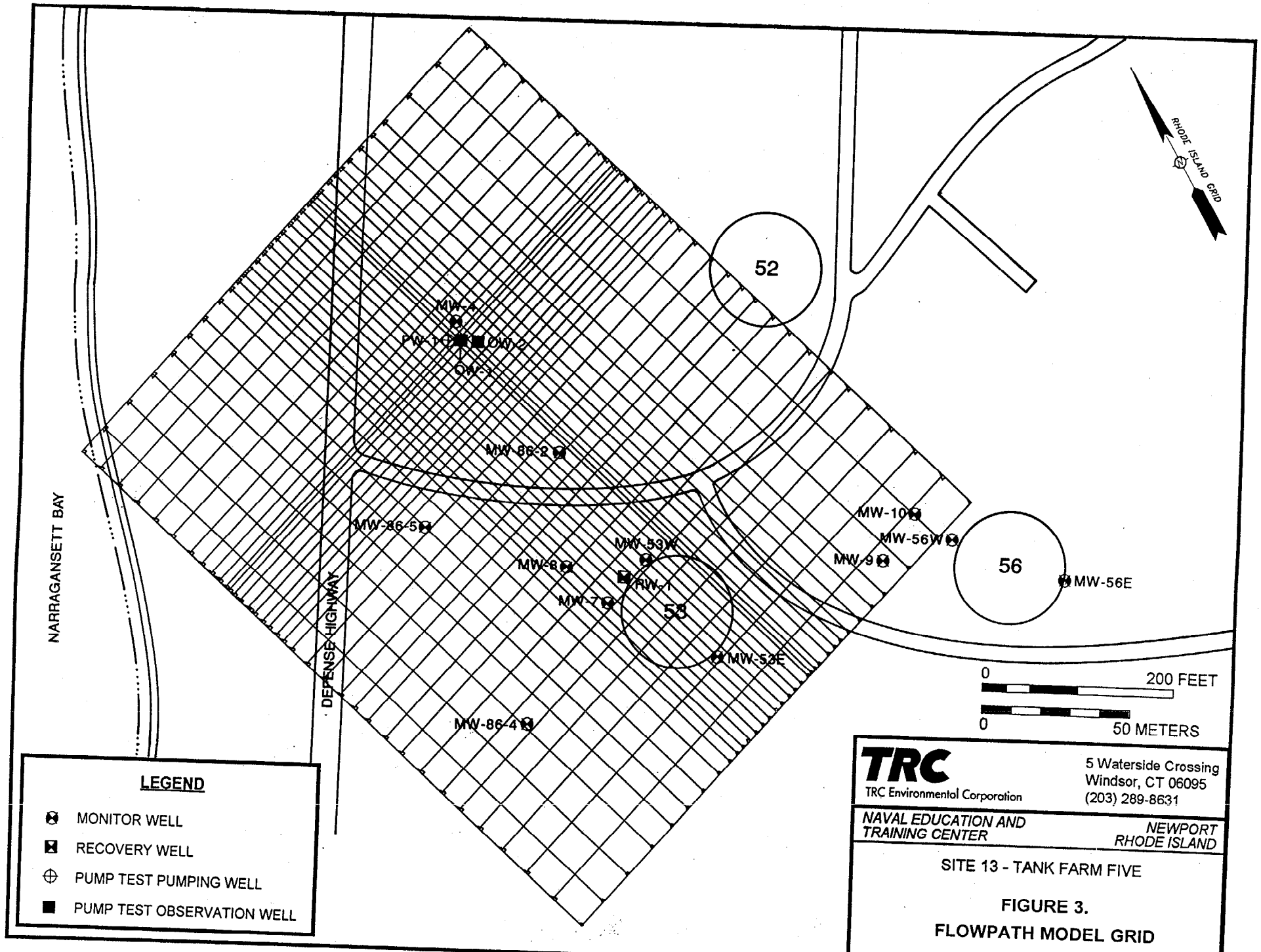
FIGURE 2.

ESTIMATED AREA OF GROUND WATER CONTAMINATED AT LEVELS IN EXCESS OF ARARS/TBCs


RHODE ISLAND GRID
52
MW-4
PW-1
OW-2
OW-1
MW-86-2
MW-86-5
MW-10
MW-56W
MW-53W
MW-8
MW-9
RW-1
MW-7
53
56
MW-56E
MW-53E
MW-86-4
NARRAGANSETT BAY
DEFENSE HIGHWAY
0
200 FEET
0
50 METERS
LEGEND
MONITOR WELL
RECOVERY WELL
PUMP TEST PUMPING WELL
PUMP TEST OBSERVATION WELL
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SITE 13 - TANK FARM FIVE
FIGURE 3.
FLOWPATH MODEL GRID

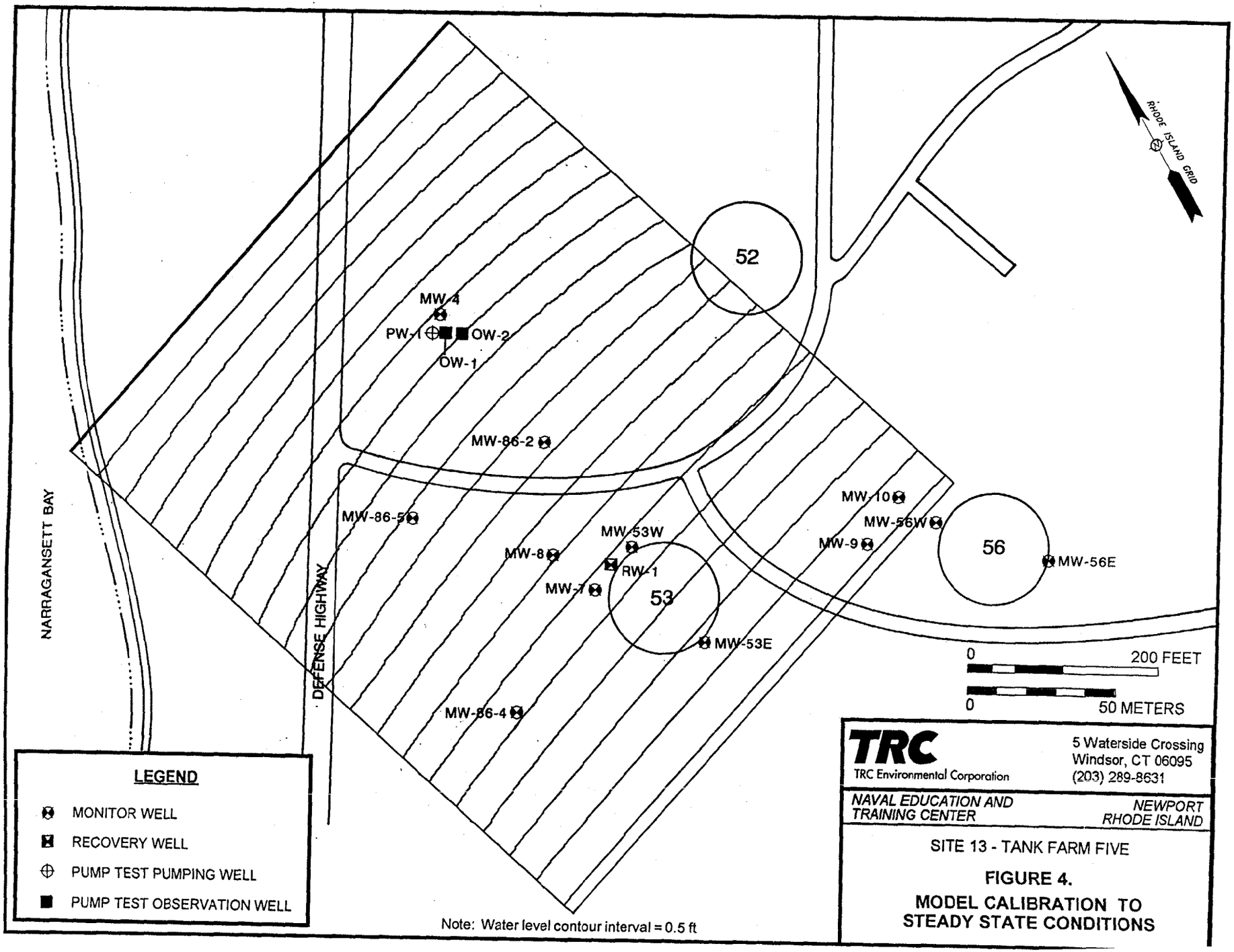
RHODE ISLAND GRID
52
MW-4
PW-1
OW-2
OW-1
MW-86-2
MW-86-5
MW-8
MW-53W
RW-1
MW-7
53
MW-53E
MW-86-4
MW-10
MW-56W
MW-9
56
MW-56E
NARRAGANSETT BAY
DEFENSE HIGHWAY
0
200 FEET
0
50 METERS
LEGEND
MONITOR WELL
RECOVERY WELL
PUMP TEST PUMPING WELL
PUMP TEST OBSERVATION WELL
Note: Water level contour interval = 0.5 ft
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FIGURE 4.
MODEL CALIBRATION TO STEADY STATE CONDITIONS

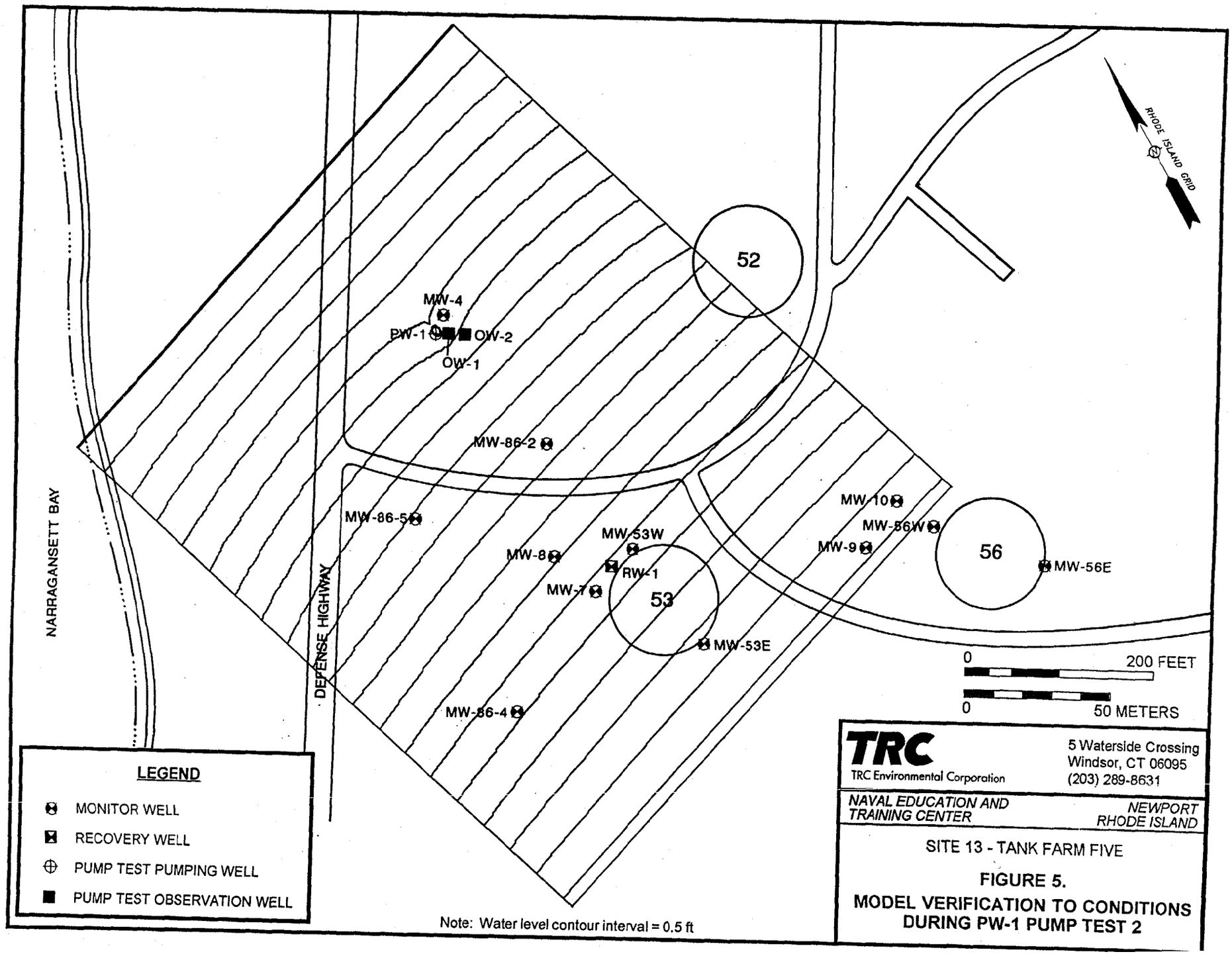
RHODE ISLAND GRID
52
MW-4
PW-1
OW-2
OW-1
MW-86-2
MW-86-5
MW-8
MW-53W
RW-1
MW-7
53
MW-53E
MW-86-4
MW-10
MW-56W
MW-9
56
MW-56E
NARRAGANSETT BAY
DEFENSE HIGHWAY
0
200 FEET
0
50 METERS
LEGEND
MONITOR WELL
RECOVERY WELL
PUMP TEST PUMPING WELL
PUMP TEST OBSERVATION WELL
Note: Water level contour interval = 0.5 ft
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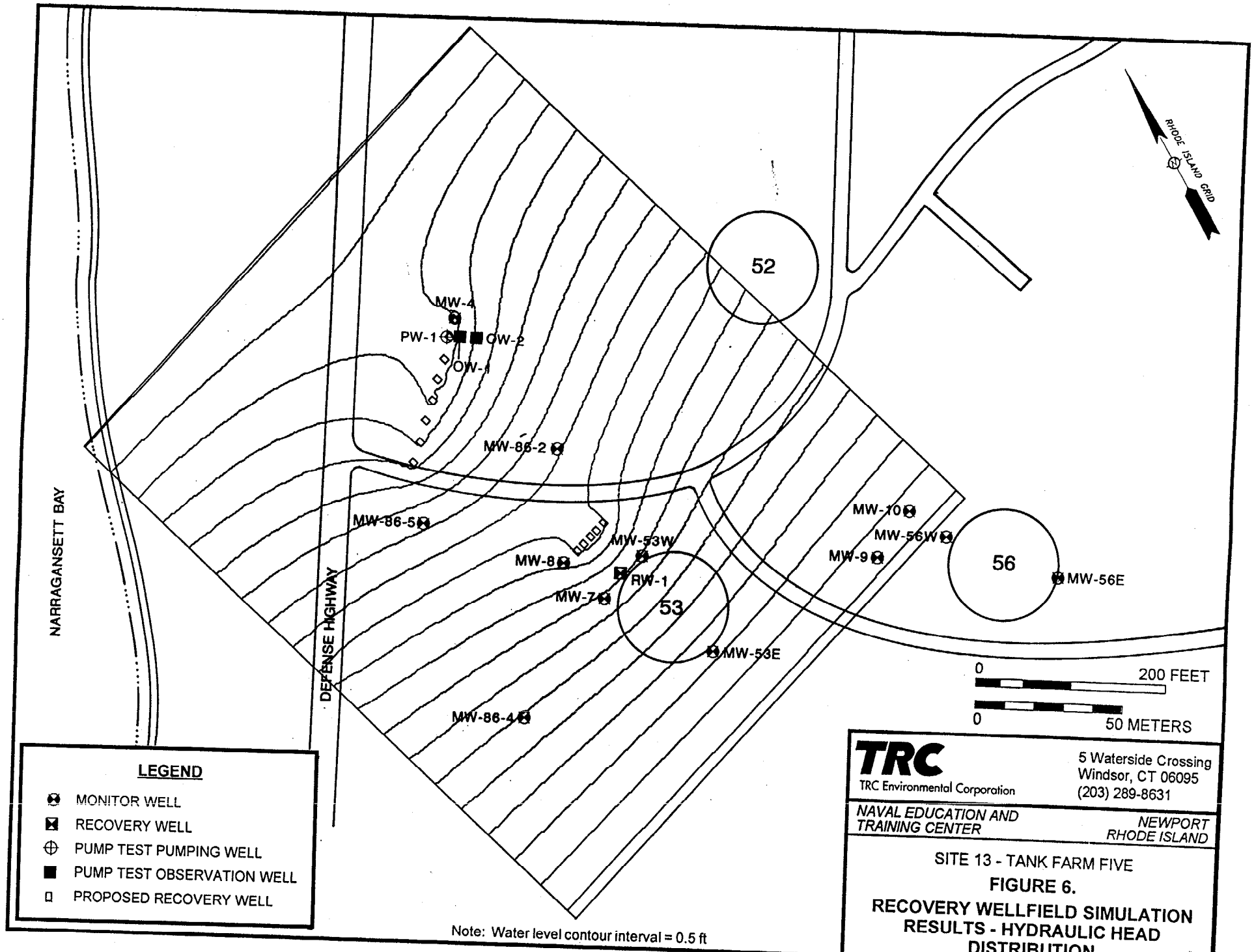
FIGURE 5.
MODEL VERIFICATION TO CONDITIONS DURING PW-1 PUMP TEST 2


RHODE ISLAND GRID
52
MW-4
PW-1
OW-2
OW-1
MW-86-2
MW-86-5
MW-8
MW-53W
RW-1
MW-7
53
MW-53E
MW-86-4
MW-10
MW-56W
MW-9
56
MW-56E
NARRAGANSETT BAY
DEFENSE HIGHWAY
0
200 FEET
0
50 METERS
LEGEND
MONITOR WELL
RECOVERY WELL
PUMP TEST PUMPING WELL
PUMP TEST OBSERVATION WELL
PROPOSED RECOVERY WELL
Note: Water level contour interval = 0.5 ft
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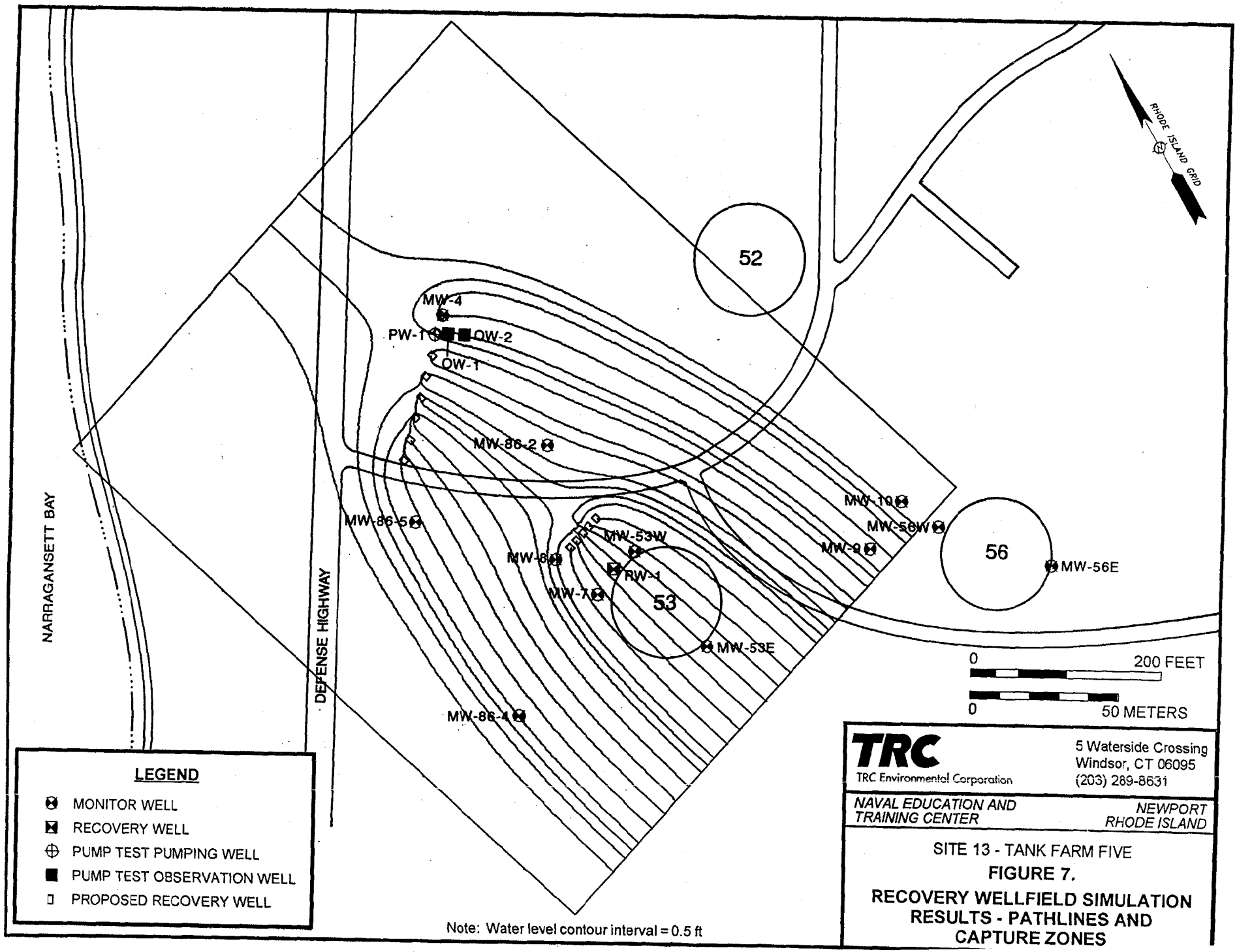
SITE 13 - TANK FARM FIVE
FIGURE 6.
RECOVERY WELLFIELD SIMULATION RESULTS - HYDRAULIC HEAD DISTRIBUTION



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SITE 13 - TANK FARM FIVE

FIGURE 7.

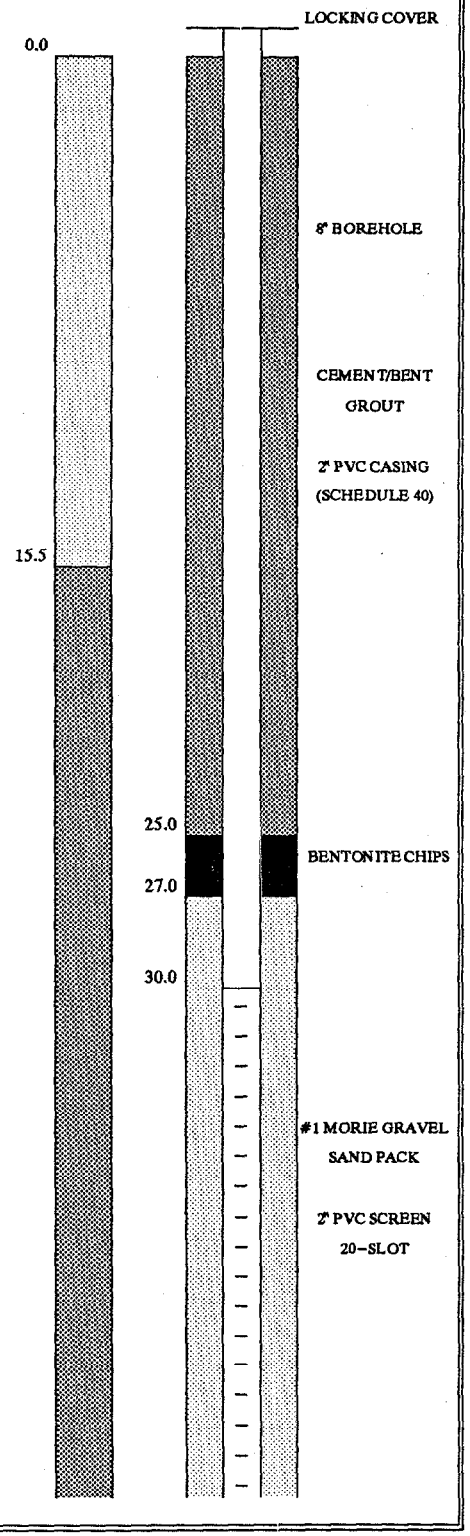
RECOVERY WELLFIELD SIMULATION RESULTS - PATHLINES AND CAPTURE ZONES

ATTACHMENT A

WELL LOGS

WELL NO:	PW-1	CONTRACTOR:	D. L. MAHER CO.	DATE STARTED:	01/08/93
PROJECT NO:	12773-Q41-01	DRILLERS:	JEFF, HARRY, BILL	DATE COMPLETED:	01/12/93
PROJECT:	U.S. NAVY - NETC	TRC INSPECTORS:	BOWDEN, BREEN	WATER TABLE EL:	
LOCATION:	NEWPORT, RI	DRILLING METHOD:	4¼" HOLLOW STEM AUGERS	LOCATION:	N
SITE:	13 - TANK FARM FIVE	GROUND EL:			E
WELL DEPTH:	50 FEET	CASING EL:			

DEPTH (FT)	BLOWS	OVA (PPM)	SOIL DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
			SEE LOG OF OW-1 FOR DESCRIPTIONS OF LITHOLOGY		



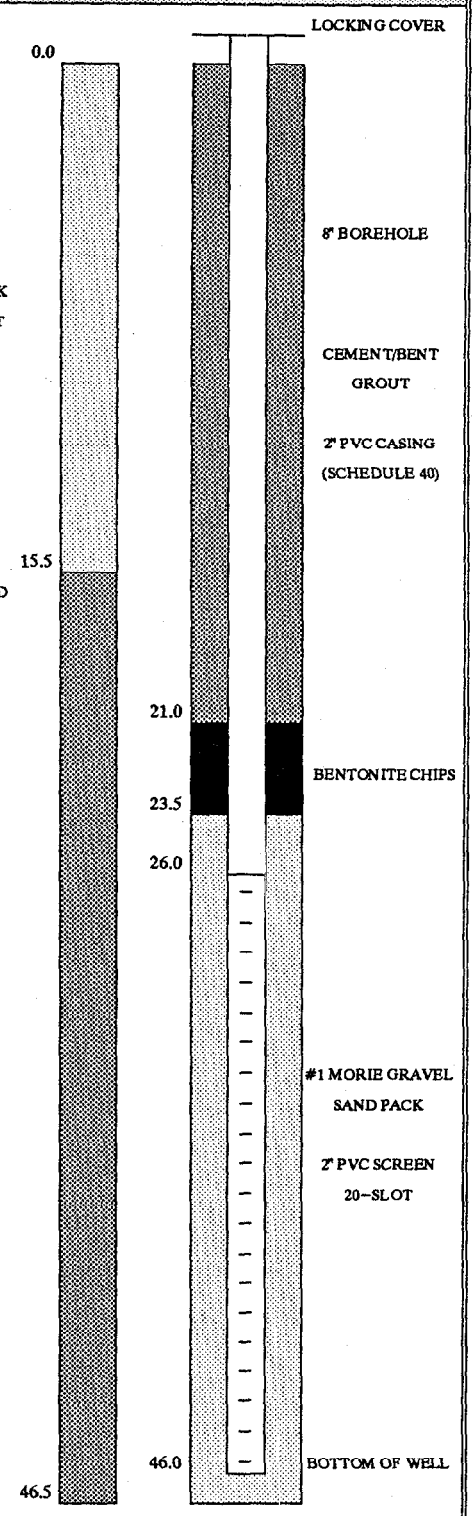
CONTINUED

U.S. NAVY – NETC
SITE 13 – TANK FARM FIVE
PW–1 CONTINUED

DEPTH (FT)	BLOWS	OVA (PPM)	SOIL DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
				47.0 50.0	BOTTOM OF WELL

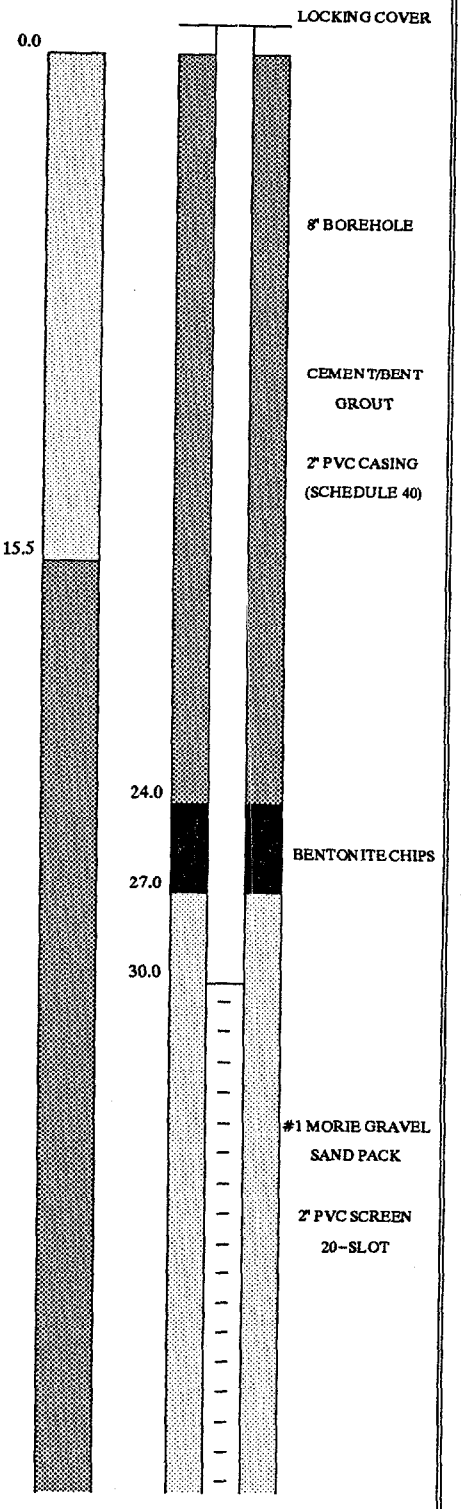
WELL NO:	OW-1	CONTRACTOR:	D. L. MAHER CO.	DATE STARTED:	01/06/93
PROJECT NO:	12773-Q41-01	DRILLERS:	JEFF, HARRY	DATE COMPLETED:	01/08/93
PROJECT:	U.S. NAVY - NETC	TRC INSPECTORS:	BOWDEN, BREEN	WATER TABLE EL:	
LOCATION:	NEWPORT, RI	DRILLING METHOD:	4¼" HOLLOW STEM AUGERS	LOCATION:	N
SITE:	13 - TANK FARM FIVE	GROUND EL:			E
WELL DEPTH:	46 FEET	CASING EL:			

DEPTH (FT)	BLOWS	OVA (PPM)	SOIL DESCRIPTION
5 - 7	13 9 6 9	1.5	0"-3": LIGHT GREY TO LIGHT BROWN FINE TO MEDIUM SAND, MOIST; TRACE SILT; 3"-12": BROWN TO LIGHT GREY FINE TO MEDIUM SAND, MOIST, WITH ORANGE FE-OXIDIZED HORIZONS; 12"-14": LIGHT TO DARK GREY SILTY FINE TO MEDIUM SAND AND FINE TO COARSE GRAVEL, WET
10 - 12	12 10 13 25	0	0"-4": DARK BROWN TO BLACK SILTY FINE SAND, MOIST; LITTLE FINE GRAVEL; 4"-7": DARK GREY TO BROWN FINE TO MEDIUM SAND, MOIST; LITTLE SILT; 7"-20": BROWN TO DARK GREY SILT AND FINE SAND, MOIST; LITTLE SHALE FRAGMENTS TO MEDIUM GRAVEL SIZE, TRACE CLAY
15 - 17	6 6 20 33	0.1	0"-4": DARK BROWN TO BLACK SILTY FINE TO MEDIUM SAND, SLIGHTLY MOIST; LITTLE FINE GRAVEL; 4"-20": LIGHT GREY TO GREY FISSILE, HIGHLY WEATHERED SHALE, SLIGHTLY MOIST, WITH ORANGE MOTTLED FE-OXIDIZED ZONES
20 - 22	100/5"		0"-1": LIGHT GREY TO GREY FISSILE, HIGHLY WEATHERED SHALE, SLIGHTLY MOIST, WITH ORANGE MOTTLED FE-OXIDIZED ZONES



WELL NO:	OW-2	CONTRACTOR:	D. L. MAHER CO.	DATE STARTED:	01/08/93
PROJECT NO:	12773-Q41-01	DRILLERS:	JEFF, HARRY, BILL	DATE COMPLETED:	01/12/93
PROJECT:	U.S. NAVY - NETC	TRC INSPECTORS:	BOWDEN, BREEN	WATER TABLE EL:	
LOCATION:	NEWPORT, RI	DRILLING METHOD:	4¼" HOLLOW STEM AUGERS	LOCATION:	N
SITE:	13 - TANK FARM FIVE	GROUND EL:			E
WELL DEPTH:	50 FEET	CASING EL:			

DEPTH (FT)	BLOWS	OVA (PPM)	SOIL DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
			SEE LOG OF OW-1 FOR DESCRIPTIONS OF LITHOLOGY		



CONTINUED

U.S. NAVY – NETC
SITE 13 – TANK FARM FIVE
OW-2 CONTINUED

DEPTH (FT)	BLOWS	OVA (PPM)	SOIL DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
				47.0 50.0	BOTTOM OF WELL

ATTACHMENT B

PUMP TEST ANALYSIS RESULTS

SUMMARY OF RESULTS
PW–1 PUMP TEST 1, FEBRUARY 11, 1993
NETC SITE 13 – TANK FARM FIVE

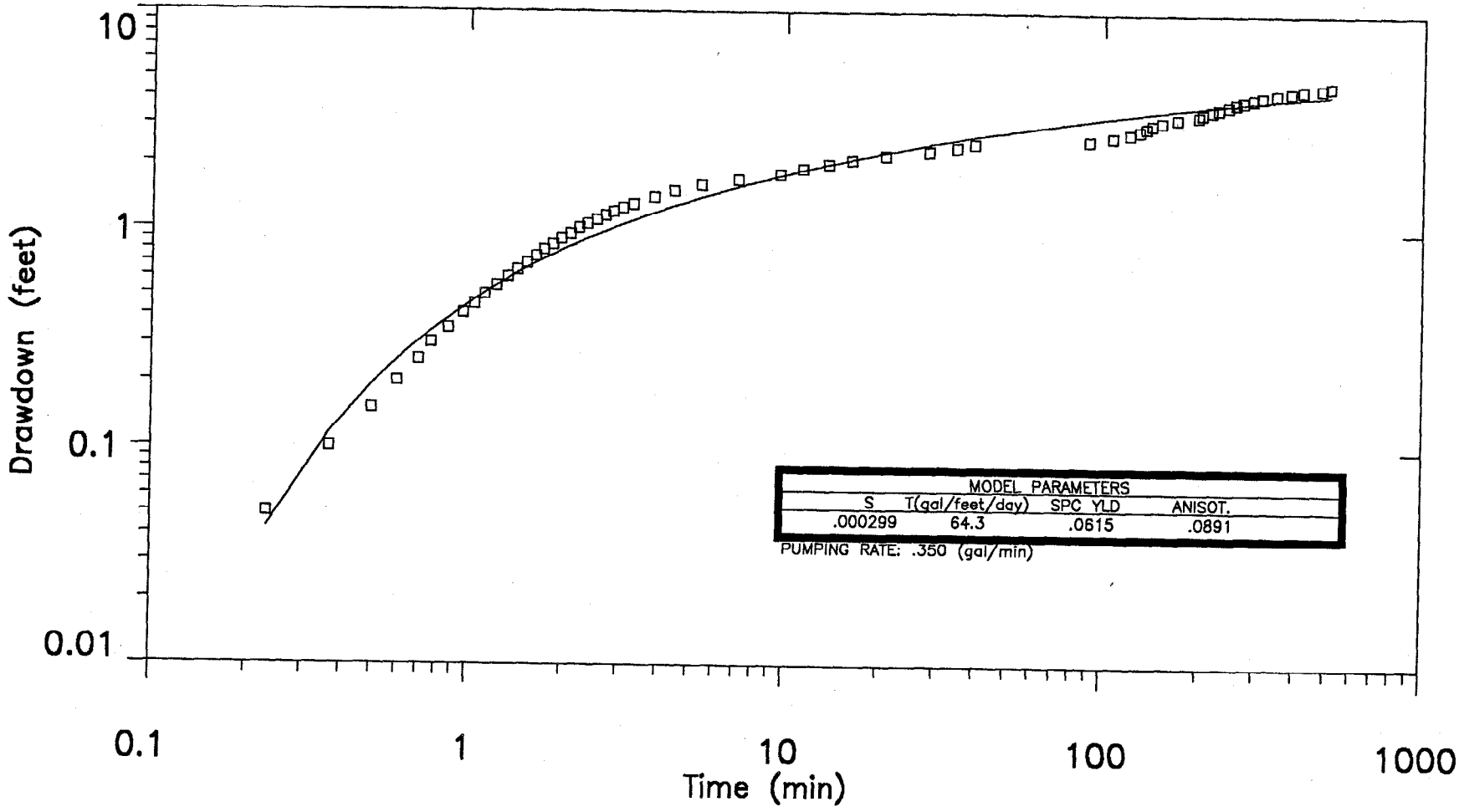
OBSERVATION WELL	DISTANCE FROM PW–1 (ft)	T (gpd/ft)	K* (ft/d)	S	SY
OW–1	5.8	64.3	0.30	3.0E–04	6.2E–02
OW–2	25.1	119.8	0.57	3.7E–04	1.0E–02
MW–4	20.5	163.2	0.77	9.4E–03	9.5E–02
AVERAGE	––	115.8	0.55	3.4E–03	5.6E–02

NOTE: * BASED ON A SATURATED AQUIFER THICKNESS OF 28.2 FEET ABOVE BOTTOM OF PW–1 SCREEN.

SUMMARY OF RESULTS
PW–1 PUMP TEST 2, MARCH 17–18, 1993
NETC SITE 13 – TANK FARM FIVE

OBSERVATION WELL	DISTANCE FROM PW–1 (ft)	T (gpd/ft)	K* (ft/d)	S	SY
OW–1:	5.8				
– PUMPING		32.0	0.14	1.5E–03	5.4E–02
– RECOVERY		40.8	0.18	1.0E–03	3.6E–01
OW–2:	25.1				
– PUMPING		134.5	0.59	7.0E–04	7.8E–03
– RECOVERY		189.2	0.83	3.7E–06	7.0E–02
MW–4:	20.5				
– PUMPING		1,352.3	5.95	1.2E–02	9.8E–02
– RECOVERY		516.3	2.27	1.7E–02	3.3E+00
AVERAGE, INCLUDING MW–4	––	377.5	1.66	5.4E–03	6.5E–01
AVERAGE, EXCLUDING MW–4	––	99.1	0.44	8.0E–04	1.2E–01

NOTE: * BASED ON A SATURATED AQUIFER THICKNESS OF 30.4 FEET ABOVE BOTTOM OF PW–1 SCREEN.



for: NAVY	PW-1 PUMP TEST, 02/11/93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 28.2 Depth: 46.2 feet Screen: Base: 28.2 Top: 8.20 feet Distance: 5.80 feet Pumping well: PW-1	Date: 11 FEB 93 | Well No.: OW-1

DATA SET: PT1OW1

CLIENT: NAVY
LOCATION: NETC - TANK FARM FIVE
COUNTY: NEWPORT, RI
PROJECT: PW-1 PUMP TEST, 02/11/93
AQUIFER: BEDROCK - RHODE ISLAND FM
WATER TABLE: 21.60 feet
PUMPING WELL No: PW-1

DATE: 11 FEB 93
WELL NO.: OW-1
FLOW RATE: 0.35 gal/min
WELL DEPTH: 46.20 feet
THICKNESS: 28.20 feet
RADIUS FROM PUMPED WELL: 5.80 feet
RADIUS OF WELL CASING: 1.000 in

The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 8.20 TO 28.20 feet
OBSERVATION WELL: SCREENED FROM 4.60 TO 24.60 feet

FITTING ERROR: 12.645 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF:	2.996E-04	TRANSM:	64.345gal/feet/day
	FREE		FREE
ANISOTROPY [SQRT(Kz/Kr)]:			0.08914
			FREE
SPECIFIC YIELD:			6.153E-02
			FREE

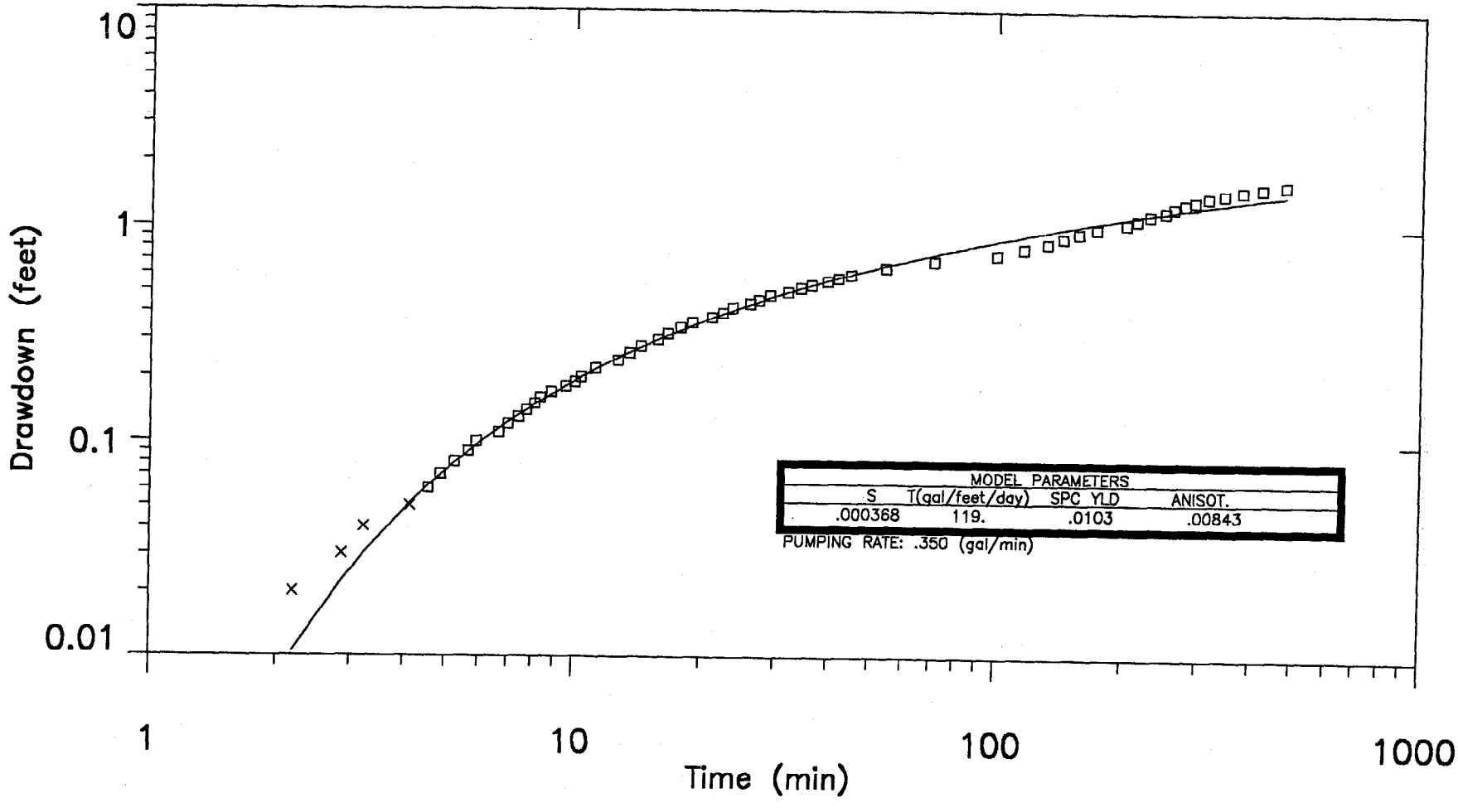
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	0.233	0.0500	0.0426	14.73
2	0.367	0.100	0.114	-14.99
3	0.500	0.150	0.192	-28.52
4	0.600	0.200	0.249	-24.59
5	0.700	0.250	0.302	-21.11
6	0.767	0.300	0.337	-12.40
7	0.867	0.350	0.386	-10.43
8	0.967	0.410	0.433	-5.76
9	1.05	0.450	0.471	-4.70
10	1.13	0.500	0.507	-1.47
11	1.23	0.550	0.549	0.161
12	1.33	0.600	0.588	1.85
13	1.43	0.650	0.626	3.60
14	1.53	0.700	0.662	5.38

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	1.63	0.750	0.696	7.17
16	1.73	0.800	0.728	8.96
17	1.85	0.850	0.763	10.14
18	1.96	0.900	0.797	11.41
19	2.10	0.950	0.833	12.29
20	2.23	1.01	0.867	14.13
21	2.36	1.05	0.900	14.28
22	2.53	1.10	0.938	14.66
23	2.70	1.15	0.975	15.15
24	2.86	1.20	1.01	15.76
25	3.06	1.25	1.05	15.93
26	3.30	1.30	1.09	15.80
27	3.83	1.40	1.18	15.32
28	4.43	1.50	1.27	14.98
29	5.41	1.60	1.40	12.48
30	7.08	1.70	1.57	7.61
31	9.58	1.80	1.76	1.90
32	11.33	1.90	1.87	1.28
33	13.66	2.00	1.99	0.0857
34	16.16	2.10	2.10	-0.422
35	20.66	2.20	2.27	-3.25
36	28.33	2.30	2.48	-7.86
37	34.66	2.40	2.61	-8.94
38	39.33	2.50	2.69	-7.92
39	89.50	2.60	3.23	-24.55
40	106.0	2.70	3.34	-23.98
41	120.0	2.80	3.42	-22.39
42	129.0	2.90	3.47	-19.75
43	135.0	3.00	3.50	-16.72
44	141.0	3.11	3.52	-13.46
45	151.0	3.20	3.57	-11.61
46	169.0	3.30	3.64	-10.36
47	197.0	3.40	3.73	-9.88
48	202.0	3.51	3.75	-6.87
49	217.0	3.60	3.79	-5.40
50	227.0	3.70	3.82	-3.27
51	244.0	3.80	3.86	-1.69
52	258.0	3.90	3.89	0.0703
53	272.0	4.00	3.92	1.79
54	292.0	4.10	3.96	3.18
55	312.0	4.20	4.00	4.58
56	346.0	4.30	4.06	5.44
57	384.0	4.41	4.12	6.49
58	418.0	4.50	4.16	7.33

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
59	480.0	4.60	4.24	7.74
60	510.0	4.70	4.27	9.04

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	1.00			
T	0.00	1.00		
B	0.00	0.00	0.00	
A	0.00	0.00	0.00	0.99
	S	T	B	A



for: NAVY	PW–1 PUMP TEST, 02/11/93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 28.2 Depth: 50.0 feet Screen: Base: 28.2 Top: 8.20 feet Distance: 25.1 feet Pumping well: PW–1	Date: 11 FEB 93 | Well No.: OW–2

DATA SET: PT1OW2

CLIENT: NAVY
DATE: 11 FEB 93
LOCATION: NETC - TANK FARM FIVE
WELL NO.: OW-2
COUNTY: NEWPORT, RI
FLOW RATE: 0.35 gal/min
PROJECT: PW-1 PUMP TEST, 02/11/93
WELL DEPTH: 50.00 feet
AQUIFER: BEDROCK - RHODE ISLAND FM
THICKNESS: 28.20 feet
WATER TABLE: 25.31 feet
PUMPING WELL No: PW-1
RADIUS FROM PUMPED WELL: 25.10 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 8.20 TO 28.20 feet
OBSERVATION WELL: SCREENED FROM 4.70 TO 24.70 feet

FITTING ERROR: 5.698 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF: 3.688E-04 FREE
TRANSM: 119.805gal/feet/day FREE
ANISOTROPY [SQRT(Kz/Kr)]: 0.00844 FREE
SPECIFIC YIELD: 1.033E-02 FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	2.20	0.0200	0.0104	47.60
2	2.86	0.0300	0.0221	26.24
3	3.23	0.0400	0.0299	25.02
4	4.13	0.0500	0.0512	-2.45
5	4.56	0.0600	0.0619	-3.23
6	4.86	0.0700	0.0694	0.793
7	5.25	0.0800	0.0790	1.15
8	5.66	0.0900	0.0895	0.493
9	5.91	0.100	0.0958	4.19
10	6.66	0.110	0.114	-3.94
11	7.00	0.120	0.122	-2.04
12	7.41	0.130	0.132	-1.92
13	7.75	0.140	0.140	-0.298
14	8.08	0.150	0.148	1.17

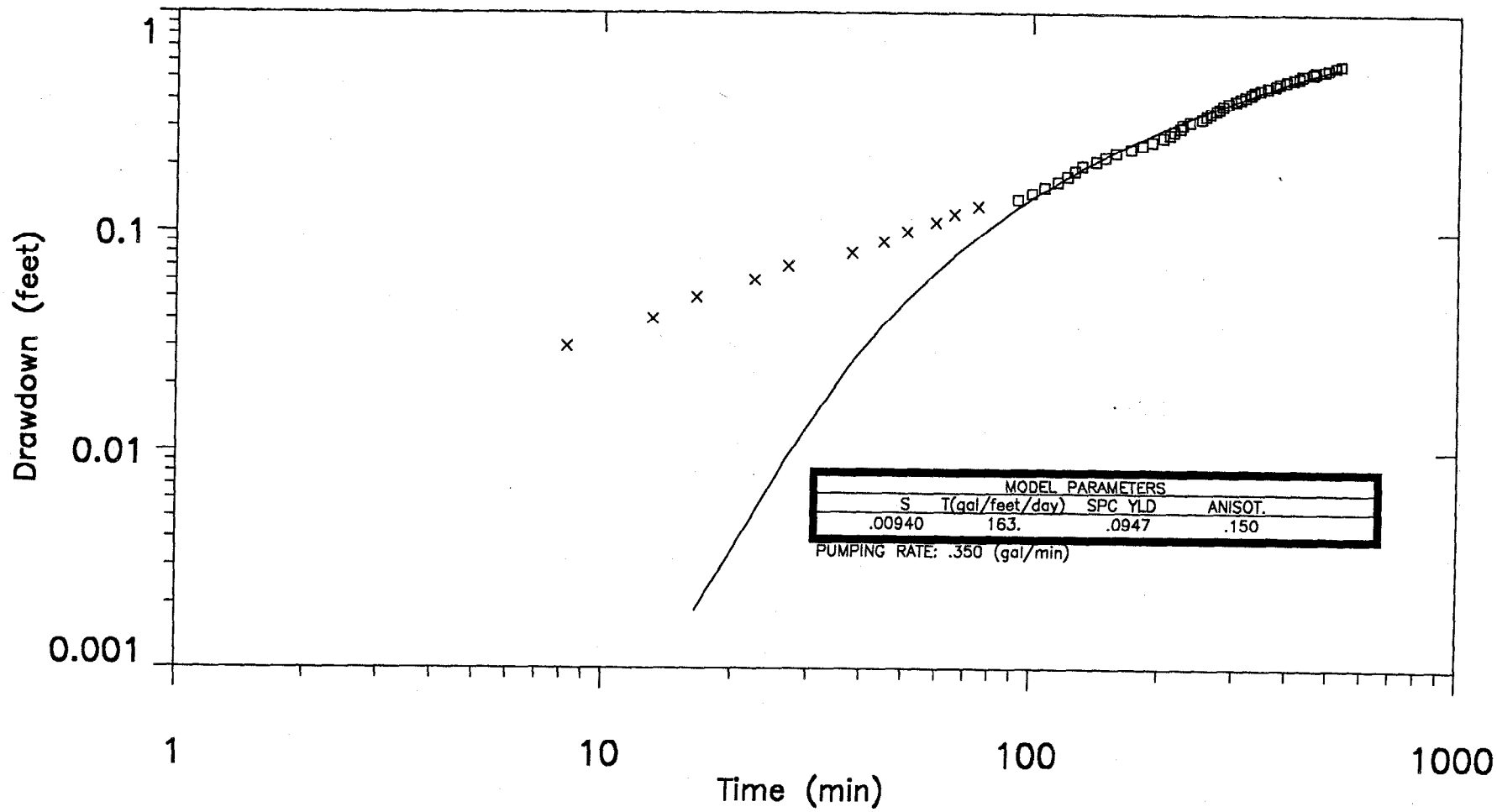
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	8.33	0.160	0.154	3.72
16	8.83	0.170	0.165	2.68
17	9.58	0.180	0.182	-1.11
18	10.08	0.190	0.192	-1.43
19	10.41	0.200	0.199	0.125
20	11.25	0.220	0.216	1.47
21	12.75	0.240	0.245	-2.39
22	13.58	0.260	0.260	-0.380
23	14.41	0.280	0.275	1.53
24	15.83	0.300	0.299	0.168
25	16.66	0.320	0.312	2.23
26	17.83	0.340	0.330	2.71
27	19.00	0.360	0.347	3.36
28	21.16	0.380	0.377	0.605
29	22.50	0.400	0.394	1.26
30	23.66	0.420	0.409	2.51
31	26.00	0.440	0.436	0.723
32	27.33	0.460	0.451	1.82
33	29.00	0.480	0.469	2.24
34	32.00	0.500	0.498	0.214
35	34.33	0.520	0.520	-0.0856
36	36.33	0.540	0.537	0.376
37	39.66	0.560	0.565	-0.979
38	42.00	0.580	0.583	-0.617
39	45.00	0.600	0.605	-0.927
40	54.33	0.650	0.666	-2.50
41	71.00	0.700	0.754	-7.82
42	100.0	0.750	0.870	-16.02
43	116.0	0.800	0.920	-15.12
44	132.0	0.850	0.965	-13.57
45	144.0	0.900	0.995	-10.63
46	157.0	0.950	1.02	-8.03
47	173.0	1.00	1.06	-6.11
48	203.0	1.05	1.11	-6.56
49	215.0	1.10	1.13	-3.61
50	230.0	1.15	1.16	-1.23
51	250.0	1.20	1.19	0.463
52	262.0	1.25	1.21	3.08
53	278.0	1.30	1.23	5.17
54	294.0	1.35	1.25	7.20
55	316.0	1.40	1.27	8.67
56	344.0	1.45	1.30	9.74
57	380.0	1.50	1.34	10.36
58	422.0	1.55	1.38	10.79

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
59	480.0	1.60	1.42	10.64

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	1.00			
T	0.00	1.00		
B	0.00	0.00	0.00	
A	0.00	-0.01	0.00	0.03

S T B A



for: NAVY	PW–1 PUMP TEST, 02/11/93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 28.2 Depth: 31.0 feet Screen: Base: 28.2 Top: 8.20 feet Distance: 20.5 feet Pumping well: PW–1	Date: 11 FEB 93 | Well No.: MW–4

DATA SET: PT1MW4

CLIENT: NAVY
LOCATION: NETC - TANK FARM FIVE
COUNTY: NEWPORT, RI
PROJECT: PW-1 PUMP TEST, 02/11/93
AQUIFER: BEDROCK - RHODE ISLAND FM
WATER TABLE: 20.31 feet

DATE: 11 FEB 93
WELL NO.: MW-4
FLOW RATE: 0.35 gal/min
WELL DEPTH: 31.00 feet
THICKNESS: 28.20 feet

PUMPING WELL No: PW-1 RADIUS FROM PUMPED WELL: 20.50 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 8.20 TO 28.20 feet
OBSERVATION WELL: SCREENED FROM 0.00 TO 11.69 feet

FITTING ERROR: 3.847 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF: 9.400E-03 TRANSM: 163.164gal/feet/day
FREE FREE
ANISOTROPY [SQRT(Kz/Kr)]: 0.15092
FREE
SPECIFIC YIELD: 9.475E-02
FREE

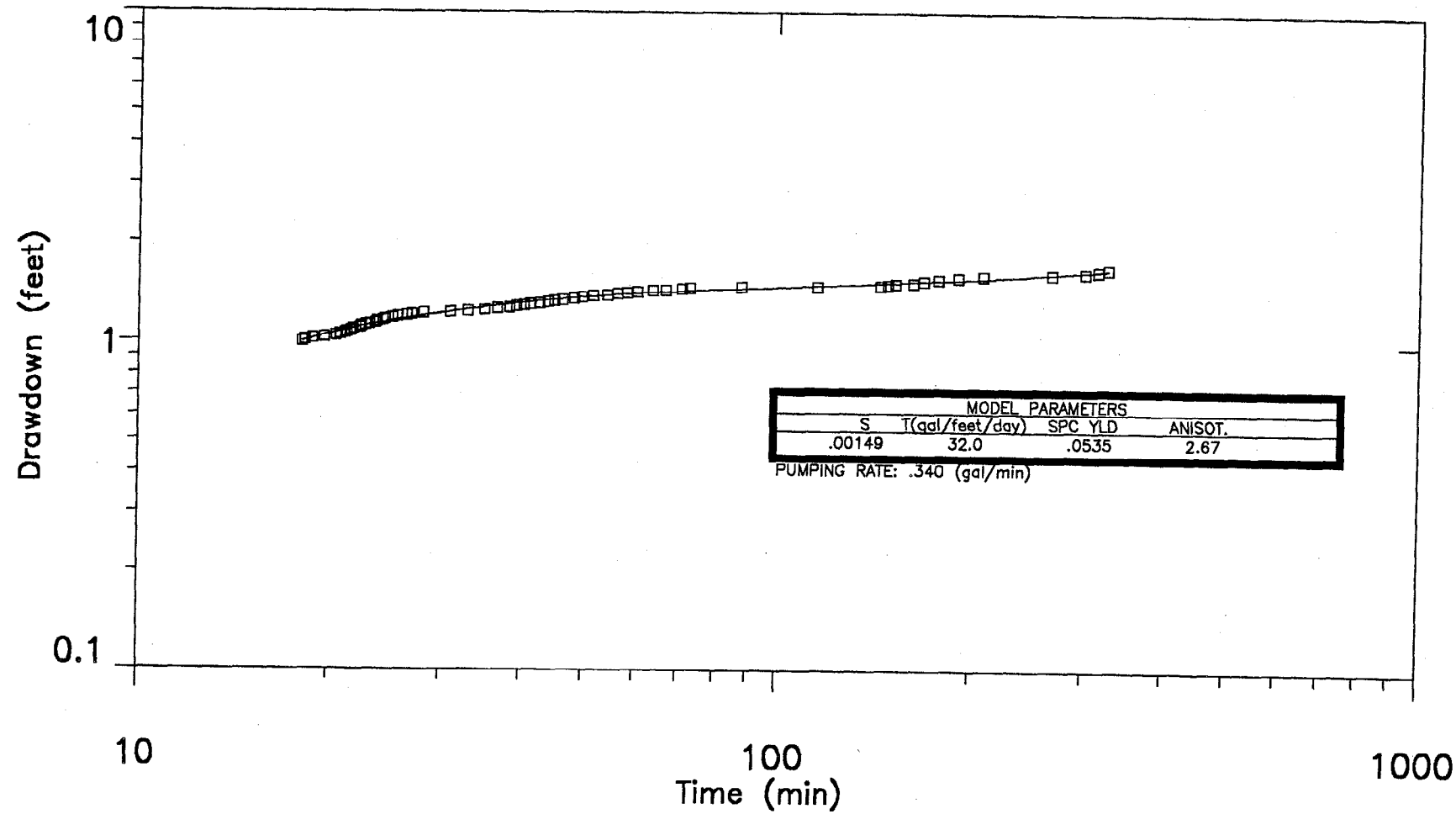
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	8.25	0.0300	1.000E-20	100.0
2	13.08	0.0400	5.588E-04	98.60
3	16.50	0.0500	0.00187	96.26
4	22.50	0.0600	0.00514	91.42
5	26.83	0.0700	0.00940	86.57
6	38.00	0.0800	0.0253	68.32
7	45.00	0.0900	0.0374	58.44
8	51.00	0.100	0.0484	51.53
9	59.66	0.110	0.0650	40.89
10	66.00	0.120	0.0773	35.56
11	75.00	0.130	0.0948	27.03
12	93.00	0.140	0.129	7.83
13	100.0	0.150	0.141	5.46
14	107.0	0.160	0.154	3.59

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	115.0	0.170	0.168	1.12
16	121.0	0.180	0.178	1.00
17	126.0	0.190	0.186	1.88
18	131.0	0.200	0.194	2.75
19	141.0	0.210	0.210	-0.0392
20	148.0	0.220	0.220	-0.278
21	157.0	0.230	0.233	-1.61
22	170.0	0.240	0.251	-4.92
23	181.0	0.250	0.266	-6.58
24	191.0	0.260	0.279	-7.42
25	203.0	0.270	0.294	-8.95
26	210.0	0.280	0.302	-8.07
27	215.0	0.290	0.308	-6.39
28	222.0	0.300	0.316	-5.56
29	225.0	0.310	0.320	-3.27
30	234.0	0.320	0.330	-3.23
31	250.0	0.330	0.347	-5.41
32	256.0	0.340	0.354	-4.18
33	262.0	0.350	0.360	-3.00
34	270.0	0.360	0.368	-2.42
35	274.0	0.370	0.372	-0.751
36	280.0	0.380	0.378	0.325
37	288.0	0.390	0.386	0.871
38	300.0	0.400	0.398	0.487
39	308.0	0.410	0.405	1.09
40	316.0	0.420	0.412	1.71
41	326.0	0.430	0.421	1.93
42	332.0	0.440	0.426	2.96
43	342.0	0.450	0.435	3.22
44	356.0	0.460	0.447	2.79
45	372.0	0.470	0.459	2.13
46	380.0	0.480	0.466	2.86
47	394.0	0.490	0.476	2.67
48	410.0	0.500	0.488	2.27
49	422.0	0.510	0.497	2.51
50	430.0	0.520	0.502	3.31
51	456.0	0.530	0.520	1.84
52	462.0	0.540	0.524	2.93
53	485.0	0.550	0.538	2.05
54	495.0	0.560	0.544	2.70
55	515.0	0.570	0.556	2.31
56	530.0	0.580	0.565	2.48

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	0.74			
T	0.13	0.25		
B	0.00	0.00	0.00	
A	0.00	0.00	0.00	1.00

S T B A



for: NAVY	PW–1 PUMP TEST, MARCH 17–18 93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 30.4 Depth: 46.2 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 5.80 feet Pumping well: PW–1	Date: MAR 17 93 | Well No.: OW–1

DATA SET: PT2OW1

CLIENT: NAVY DATE: MAR 17 93
LOCATION: NETC - TANK FARM FIVE WELL NO.: OW-1
COUNTY: NEWPORT, RI FLOW RATE: 0.34 gal/min
PROJECT: PW-1 PUMP TEST, MARCH 17-18 93 WELL DEPTH: 46.20 feet
AQUIFER: BEDROCK - RHODE ISLAND FM THICKNESS: 30.40 feet
WATER TABLE: 19.00 feet
PUMPING WELL No: PW-1 RADIUS FROM PUMPED WELL: 5.80 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 10.40 TO 30.40 feet
OBSERVATION WELL: SCREENED FROM 6.80 TO 26.80 feet

FITTING ERROR: 1.333 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF: 1.495E-03 TRANSM: 32.026gal/feet/day
FREE FREE
ANISOTROPY [SQRT(Kz/Kr)]: 2.66867
FREE
SPECIFIC YIELD: 5.353E-02
FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	18.16	1.00	0.999	0.100
2	18.33	1.01	1.00	0.589
3	18.83	1.02	1.01	0.117
4	19.66	1.03	1.04	-1.15
5	20.50	1.04	1.06	-2.22
6	20.83	1.05	1.07	-2.01
7	21.16	1.06	1.07	-1.78
8	21.33	1.07	1.08	-1.18
9	21.66	1.08	1.09	-0.939
10	21.83	1.09	1.09	-0.343
11	22.33	1.10	1.10	-0.385
12	22.50	1.11	1.10	0.213
13	22.83	1.12	1.11	0.514
14	23.16	1.13	1.12	0.827

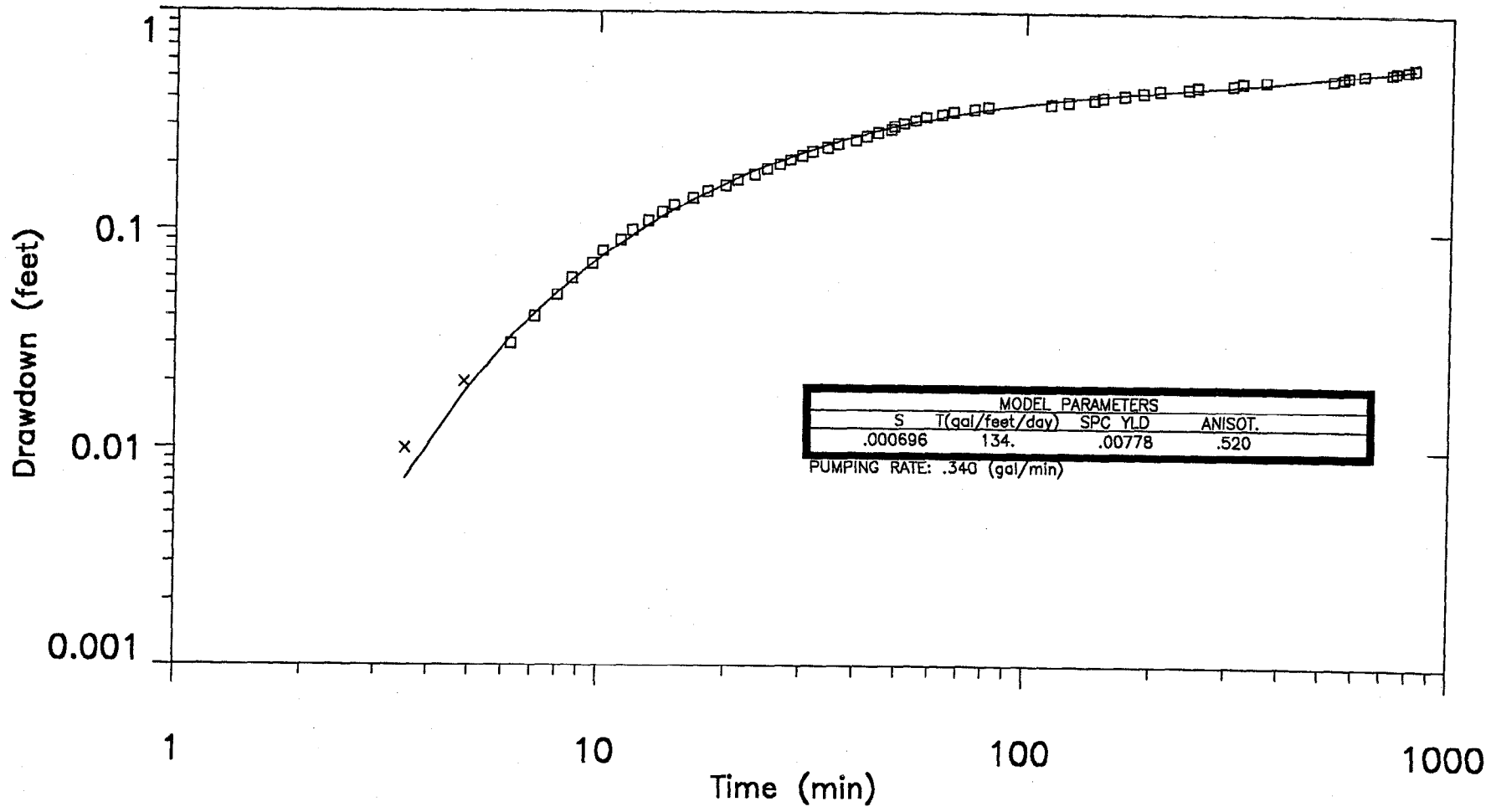
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	23.66	1.14	1.12	0.887
16	23.83	1.15	1.13	1.49
17	24.33	1.16	1.14	1.59
18	24.50	1.17	1.14	2.19
19	25.16	1.18	1.15	2.10
20	25.66	1.19	1.16	2.28
21	26.50	1.20	1.17	2.08
22	27.00	1.21	1.18	2.32
23	28.16	1.22	1.19	1.86
24	31.00	1.23	1.23	-0.0577
25	33.00	1.24	1.25	-0.953
26	35.00	1.25	1.27	-1.68
27	36.66	1.26	1.28	-2.03
28	38.33	1.27	1.29	-2.29
29	39.33	1.28	1.30	-2.08
30	40.33	1.29	1.31	-1.85
31	41.33	1.30	1.32	-1.59
32	42.66	1.31	1.32	-1.48
33	44.00	1.32	1.33	-1.32
34	45.00	1.33	1.34	-0.999
35	46.33	1.34	1.35	-0.789
36	48.33	1.36	1.36	-0.0521
37	49.66	1.37	1.36	0.221
38	51.66	1.38	1.37	0.316
39	54.33	1.39	1.38	0.289
40	56.33	1.40	1.39	0.506
41	58.33	1.41	1.39	0.765
42	60.50	1.42	1.40	1.02
43	64.00	1.43	1.41	1.10
44	67.00	1.44	1.42	1.34
45	71.00	1.45	1.42	1.48
46	73.00	1.46	1.43	1.91
47	88.00	1.47	1.45	0.981
48	115.5	1.48	1.48	-0.542
49	145.0	1.49	1.51	-1.80
50	149.0	1.50	1.52	-1.37
51	153.0	1.51	1.52	-0.944
52	163.0	1.52	1.53	-0.869
53	169.0	1.54	1.53	0.0964
54	178.0	1.56	1.54	0.872
55	191.0	1.58	1.55	1.41
56	209.0	1.60	1.57	1.66
57	268.0	1.62	1.62	-0.246
58	302.0	1.64	1.65	-0.769

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
59	316.0	1.66	1.66	-0.257
60	328.0	1.68	1.67	0.345

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	1.00			
T	0.00	0.87		
B	0.00	0.16	0.79	
A	0.00	0.10	-0.13	0.91

S T B A



for: NAVY	PW–1 PUMP TEST, MARCH 17–18 93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 30.4 Depth: 50.0 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 25.1 feet Pumping well: PW=1	Date: MAR 17 93 | Well No.: OW–2

DATA SET: PT2OW2

CLIENT: NAVY DATE: MAR 17 93
LOCATION: NETC - TANK FARM FIVE WELL NO.: OW-2
COUNTY: NEWPORT, RI FLOW RATE: 0.34 gal/min
PROJECT: PW-1 PUMP TEST, MARCH 17-18 93 WELL DEPTH: 50.00 feet
AQUIFER: BEDROCK - RHODE ISLAND FM THICKNESS: 30.40 feet
WATER TABLE: 22.90 feet
PUMPING WELL No: PW=1 RADIUS FROM PUMPED WELL: 25.10 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 10.40 TO 30.40 feet
OBSERVATION WELL: SCREENED FROM 6.80 TO 26.80 feet

FITTING ERROR: 2.832 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

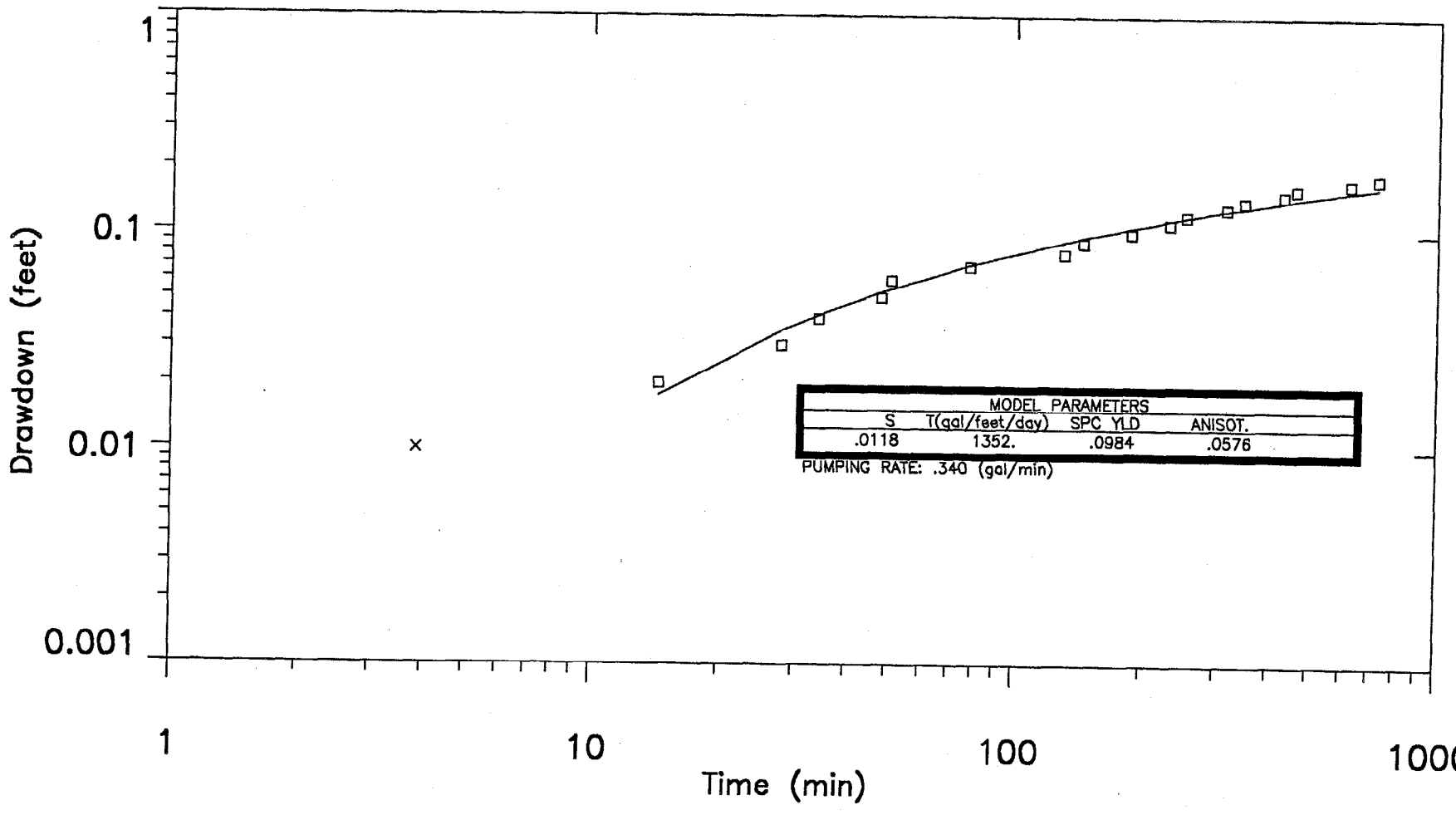
STORAGE COEF: 6.958E-04 TRANSM: 134.469gal/feet/day
FREE FREE
ANISOTROPY [SQRT(Kz/Kr)]: 0.52038
FREE
SPECIFIC YIELD: 7.786E-03
FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	3.53	0.0100	0.00720	28.03
2	4.86	0.0200	0.0179	10.36
3	6.25	0.0300	0.0321	-7.06
4	7.08	0.0400	0.0411	-2.92
5	8.00	0.0500	0.0513	-2.63
6	8.66	0.0600	0.0587	2.13
7	9.66	0.0700	0.0696	0.466
8	10.25	0.0800	0.0759	5.05
9	11.25	0.0900	0.0865	3.87
10	12.00	0.100	0.0942	5.75
11	13.08	0.110	0.105	4.45
12	14.08	0.120	0.114	4.38
13	15.00	0.130	0.123	5.19
14	16.66	0.140	0.137	1.48

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	18.00	0.150	0.148	0.693
16	19.83	0.160	0.163	-1.99
17	21.16	0.170	0.172	-1.70
18	23.16	0.180	0.186	-3.63
19	24.83	0.190	0.197	-3.74
20	26.66	0.200	0.208	-4.00
21	28.16	0.210	0.216	-3.03
22	30.00	0.220	0.225	-2.71
23	31.66	0.230	0.234	-1.81
24	34.33	0.240	0.246	-2.64
25	36.33	0.250	0.254	-1.91
26	40.00	0.260	0.269	-3.46
27	42.33	0.270	0.277	-2.68
28	45.00	0.280	0.285	-2.13
29	48.33	0.290	0.295	-2.04
30	49.00	0.300	0.297	0.728
31	51.66	0.310	0.304	1.61
32	55.00	0.320	0.313	2.10
33	58.33	0.330	0.320	2.76
34	63.50	0.340	0.331	2.48
35	67.50	0.350	0.338	3.15
36	75.50	0.360	0.351	2.25
37	81.50	0.370	0.360	2.66
38	114.5	0.380	0.392	-3.29
39	126.0	0.390	0.400	-2.65
40	145.0	0.400	0.410	-2.73
41	152.0	0.410	0.414	-1.06
42	171.0	0.420	0.422	-0.635
43	189.0	0.430	0.429	0.136
44	207.0	0.440	0.435	1.05
45	242.0	0.450	0.445	0.972
46	254.0	0.460	0.448	2.41
47	308.0	0.470	0.462	1.57
48	324.0	0.480	0.466	2.83
49	368.0	0.490	0.476	2.76
50	530.0	0.500	0.510	-2.18
51	560.0	0.510	0.516	-1.36
52	575.0	0.520	0.519	0.00817
53	625.0	0.530	0.529	0.0478
54	725.0	0.540	0.548	-1.59
55	740.0	0.550	0.551	-0.245
56	790.0	0.560	0.560	-0.0617
57	820.0	0.570	0.565	0.766

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	1.00			
T	0.00	1.00		
B	0.00	0.00	1.00	
A	0.00	0.00	0.00	1.00
	S	T	B	A



for: NAVY	PW–1 PUMP TEST, MARCH 17–18 93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 30.4 Depth: 31.0 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 20.5 feet Pumping well: PW–1	Date: MAR 17 93 | Well No.: MW–4

DATA SET: PT2MW4

CLIENT: NAVY
DATE: MAR 17 93
LOCATION: NETC - TANK FARM FIVE
WELL NO.: MW-4
COUNTY: NEWPORT, RI
FLOW RATE: 0.34 gal/min
PROJECT: PW-1 PUMP TEST, MARCH 17-18 93
WELL DEPTH: 31.00 feet
AQUIFER: BEDROCK - RHODE ISLAND FM
THICKNESS: 30.40 feet
WATER TABLE: 18.60 feet
PUMPING WELL No: PW-1
RADIUS FROM PUMPED WELL: 20.50 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 10.40 TO 30.40 feet
OBSERVATION WELL: SCREENED FROM 0.00 TO 12.40 feet

FITTING ERROR: 8.508 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

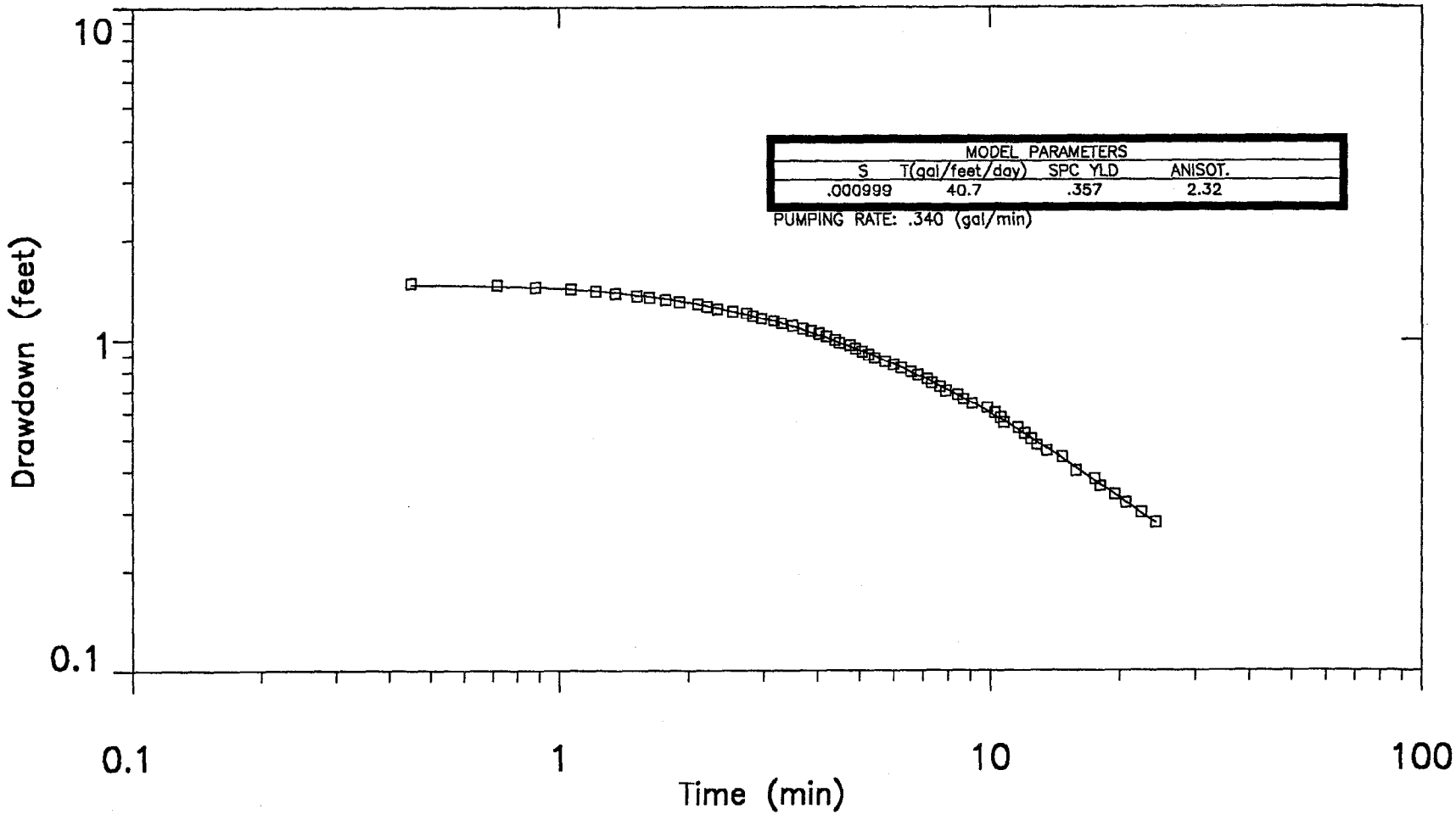
STORAGE COEF: 1.189E-02 TRANSM: 1352.303gal/feet/day
FREE FREE
ANISOTROPY [SQRT(Kz/Kr)]: 0.05761
FREE
SPECIFIC YIELD: 9.845E-02
FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	3.86	0.0100	7.150E-04	92.84
2	14.41	0.0200	0.0176	11.91
3	28.00	0.0300	0.0351	-17.21
4	34.33	0.0400	0.0416	-4.01
5	48.33	0.0500	0.0533	-6.73
6	51.00	0.0600	0.0553	7.81
7	78.50	0.0700	0.0715	-2.20
8	131.0	0.0800	0.0917	-14.72
9	145.0	0.0900	0.0959	-6.57
10	188.0	0.100	0.106	-6.66
11	232.0	0.110	0.115	-4.93
12	254.0	0.120	0.119	0.647
13	316.0	0.130	0.128	1.17
14	348.0	0.140	0.132	5.31

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	434.0	0.150	0.142	5.32
16	464.0	0.160	0.144	9.42
17	625.0	0.170	0.157	7.13
18	725.0	0.180	0.164	8.70

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	0.31			
T	0.12	0.29		
B	0.00	0.00	0.00	
A	0.09	0.01	0.00	0.03
	S	T	B	A



for: NAVY	PW-1 PT RECOVERY, MARCH 18 93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 30.4 Depth: 46.2 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 5.80 feet Pumping well: PW-1	Date: MAR 18 93 | Well No.: OW-1

DATA SET: PT2OW1R

CLIENT: NAVY
LOCATION: NETC - TANK FARM FIVE
COUNTY: NEWPORT, RI
PROJECT: PW-1 PT RECOVERY, MARCH 18 93
AQUIFER: BEDROCK - RHODE ISLAND FM
WATER TABLE: 19.00 feet
PUMPING WELL No: PW-1
RADIUS OF WELL CASING: 1.000 in
DATE: MAR 18 93
WELL NO.: OW-1
FLOW RATE: 0.34 gal/min
WELL DEPTH: 46.20 feet
THICKNESS: 30.40 feet
DURATION OF PUMPING: 1442.00 min
RADIUS FROM PUMPED WELL: 5.80 feet

The following depths are from top of Aquifer:

PUMPING WELL: SCREENED FROM 10.40 TO 30.40 feet
OBSERVATION WELL: SCREENED FROM 6.80 TO 26.80 feet

FITTING ERROR: 0.912 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF: 9.991E-04 FREE
TRANSM: 40.757gal/feet/day FREE
ANISOTROPY [SQRT(Kz/Kr)]: 2.32130 FREE
SPECIFIC YIELD: 3.577E-01 FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	0.450	1.48	1.46	1.31
2	0.717	1.46	1.45	0.621
3	0.883	1.44	1.43	0.0724
4	1.06	1.42	1.42	-0.0839
5	1.21	1.40	1.40	-0.293
6	1.35	1.38	1.38	-0.544
7	1.51	1.36	1.36	-0.383
8	1.61	1.34	1.35	-0.844
9	1.76	1.32	1.33	-0.758
10	1.90	1.30	1.31	-0.843
11	2.10	1.28	1.28	-0.179
12	2.20	1.26	1.26	-0.634
13	2.33	1.24	1.24	-0.731
14	2.53	1.22	1.22	-0.0729

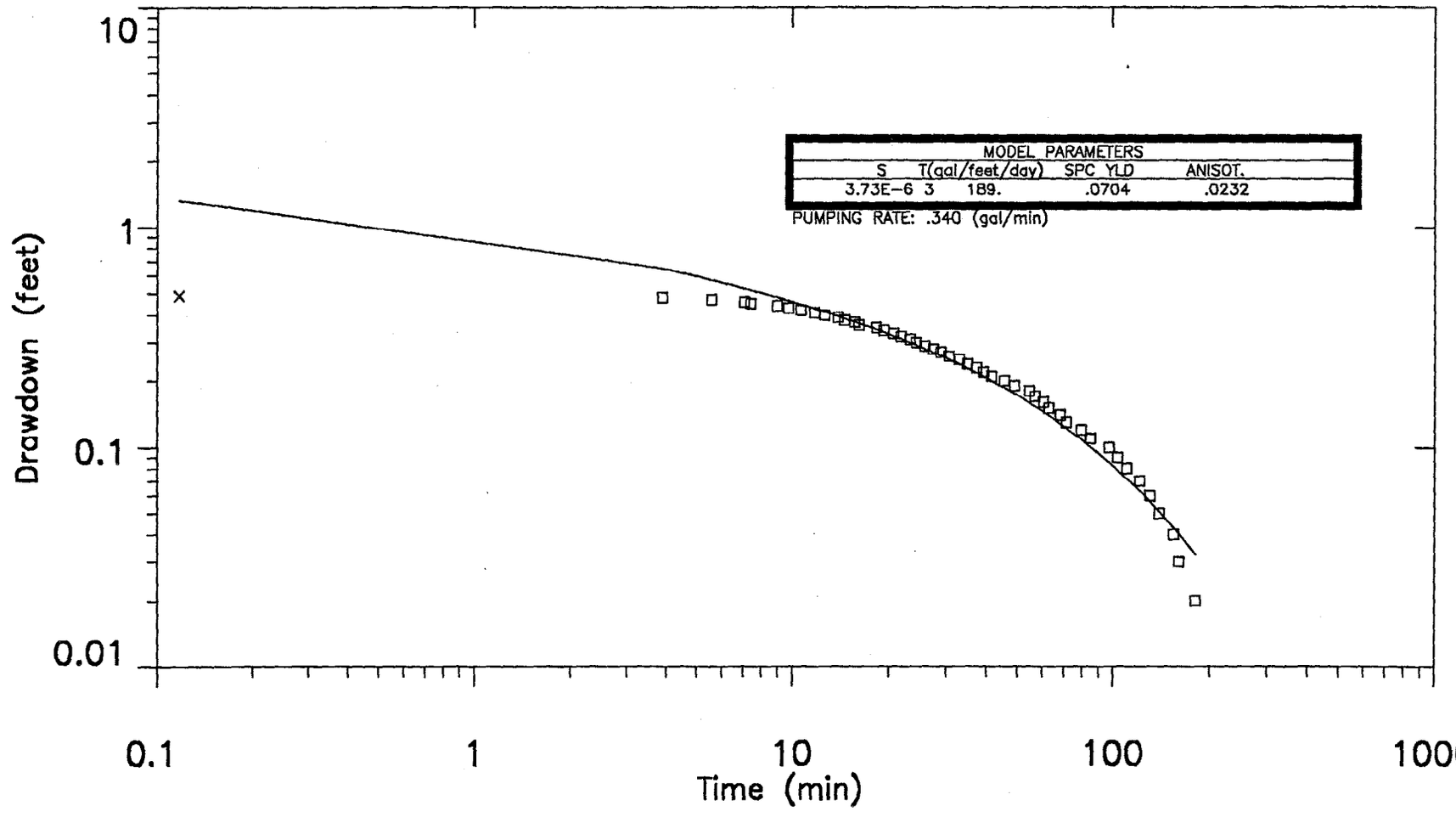
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	2.73	1.20	1.19	0.564
16	2.83	1.18	1.17	0.0310
17	2.96	1.16	1.16	-0.148
18	3.16	1.14	1.13	0.382
19	3.30	1.12	1.11	0.113
20	3.50	1.10	1.09	0.553
21	3.70	1.08	1.06	0.940
22	3.86	1.06	1.05	0.913
23	4.03	1.04	1.03	0.826
24	4.20	1.02	1.01	0.697
25	4.40	1.00	0.991	0.864
26	4.50	0.980	0.980	-0.0870
27	4.76	0.960	0.953	0.660
28	4.90	0.940	0.940	-0.0599
29	5.08	0.920	0.923	-0.327
30	5.25	0.900	0.907	-0.827
31	5.41	0.880	0.892	-1.39
32	5.75	0.860	0.863	-0.390
33	6.00	0.840	0.842	-0.313
34	6.25	0.820	0.822	-0.331
35	6.58	0.800	0.797	0.326
36	6.83	0.780	0.779	0.101
37	7.16	0.760	0.755	0.533
38	7.33	0.740	0.744	-0.648
39	7.66	0.720	0.723	-0.439
40	7.91	0.700	0.707	-1.09
41	8.41	0.680	0.678	0.263
42	8.66	0.660	0.664	-0.646
43	9.08	0.640	0.642	-0.336
44	9.83	0.620	0.605	2.35
45	10.25	0.600	0.586	2.23
46	10.58	0.580	0.572	1.33
47	10.75	0.560	0.565	-0.944
48	11.58	0.540	0.532	1.36
49	12.00	0.520	0.517	0.487
50	12.41	0.500	0.503	-0.602
51	12.83	0.480	0.489	-1.93
52	13.50	0.460	0.468	-1.88
53	14.66	0.440	0.436	0.849
54	15.83	0.400	0.408	-2.01
55	17.50	0.380	0.373	1.68
56	18.00	0.360	0.364	-1.21
57	19.50	0.340	0.339	0.263
58	20.66	0.320	0.321	-0.567

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
59	22.50	0.300	0.298	0.546
60	24.33	0.280	0.278	0.422

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	1.00			
T	0.00	0.98		
B	-0.01	0.02	0.97	
A	0.00	0.02	-0.02	0.98

S T B A



for: NAVY	PW-1 PT RECOVERY, MARCH 18 93
by: TRC Environmental Consultants, Inc.	NETC - TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK - RHODE ISLAND FM Thickness: 30.4 Depth: 50.0 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 25.1 feet Pumping well: PW-1	Date: MAR 18 93 | Well No.: OW-2

DATA SET: PT2OW2R

CLIENT: NAVY
DATE: MAR 18 93
LOCATION: NETC - TANK FARM FIVE
WELL NO.: OW-2
COUNTY: NEWPORT, RI
FLOW RATE: 0.34 gal/min
PROJECT: PW-1 PT RECOVERY, MARCH 18 93
WELL DEPTH: 50.00 feet
AQUIFER: BEDROCK - RHODE ISLAND FM
THICKNESS: 30.40 feet
WATER TABLE: 22.90 feet
DURATION OF PUMPING: 1442.00 min
PUMPING WELL No: PW-1
RADIUS FROM PUMPED WELL: 25.10 feet
RADIUS OF WELL CASING: 1.000 in
The following depths are from top of Aquifer:
PUMPING WELL: SCREENED FROM 10.40 TO 30.40 feet
OBSERVATION WELL: SCREENED FROM 6.80 TO 26.80 feet

FITTING ERROR: 12.831 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF: 3.732E-06 TRANSM: 189.205gal/feet/day
FREE FREE
ANISOTROPY [SQRT(Kz/Kr)]: 0.02329
FREE
SPECIFIC YIELD: 7.043E-02
FREE

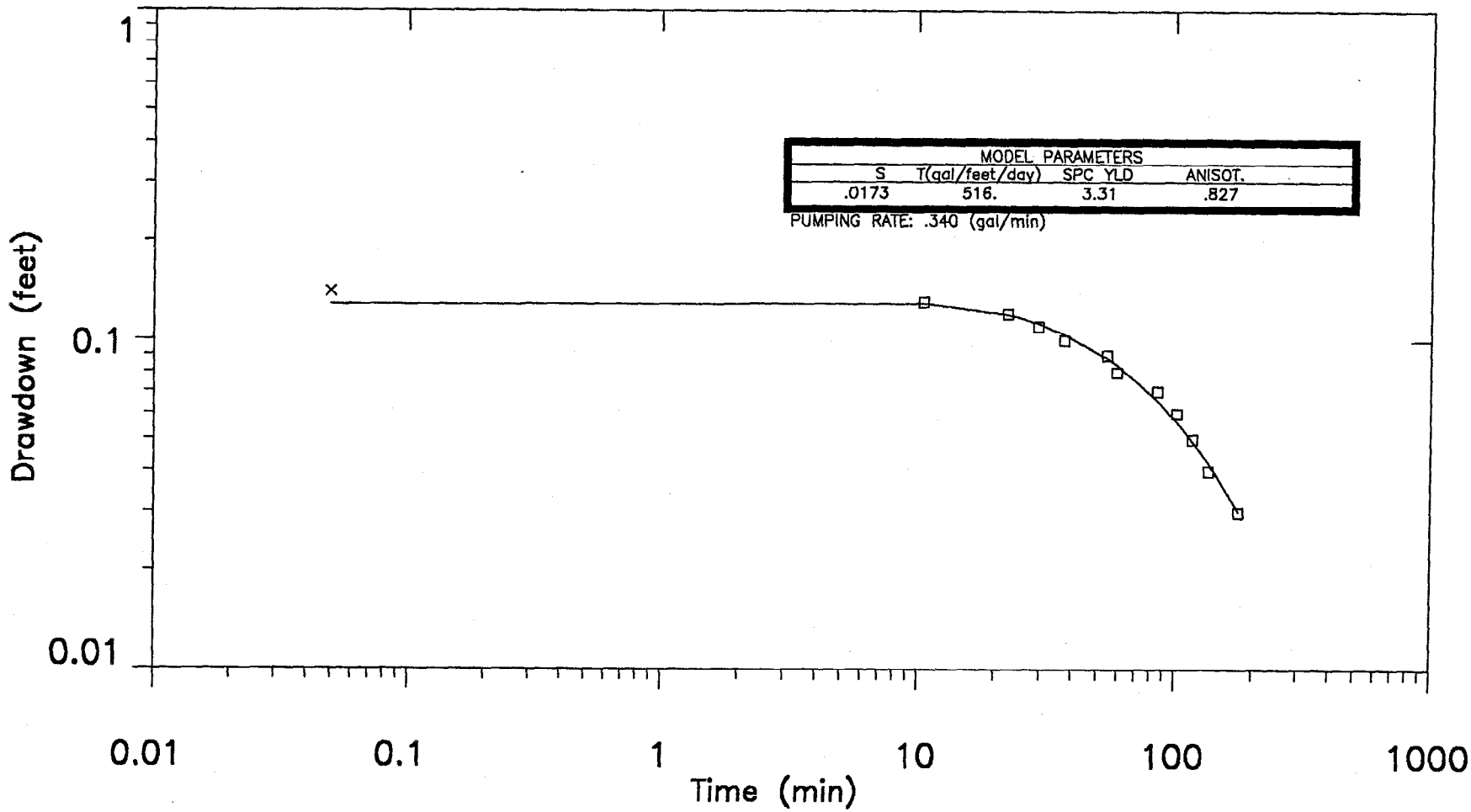
No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	0.117	0.490	1.32	-169.7
2	3.90	0.480	0.647	-34.97
3	5.58	0.470	0.575	-22.40
4	7.08	0.460	0.527	-14.70
5	7.41	0.450	0.518	-15.21
6	9.00	0.440	0.480	-9.09
7	9.75	0.430	0.464	-7.95
8	10.66	0.420	0.446	-6.34
9	11.75	0.410	0.427	-4.37
10	12.66	0.400	0.413	-3.34
11	13.91	0.390	0.395	-1.33
12	14.58	0.380	0.386	-1.65
13	15.66	0.370	0.372	-0.718
14	16.16	0.360	0.366	-1.87

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
15	18.33	0.350	0.343	1.90
16	19.33	0.340	0.333	1.91
17	20.66	0.330	0.321	2.67
18	21.83	0.320	0.311	2.77
19	23.33	0.310	0.299	3.51
20	24.33	0.300	0.291	2.81
21	25.83	0.290	0.280	3.11
22	27.50	0.280	0.270	3.56
23	29.00	0.270	0.260	3.39
24	30.66	0.260	0.251	3.36
25	33.00	0.250	0.238	4.49
26	35.00	0.240	0.228	4.63
27	37.33	0.230	0.218	5.13
28	39.33	0.220	0.209	4.67
29	41.66	0.210	0.200	4.50
30	45.66	0.200	0.186	6.86
31	49.00	0.190	0.175	7.63
32	54.66	0.180	0.159	11.57
33	57.00	0.170	0.153	9.94
34	60.50	0.160	0.144	9.60
35	63.00	0.150	0.139	7.32
36	68.50	0.140	0.127	8.75
37	71.50	0.130	0.122	6.04
38	79.50	0.120	0.108	9.40
39	85.00	0.110	0.100	8.57
40	97.00	0.100	0.0854	14.57
41	103.5	0.0900	0.0785	12.76
42	110.5	0.0800	0.0718	10.14
43	121.0	0.0700	0.0631	9.72
44	130.0	0.0600	0.0566	5.52
45	139.0	0.0500	0.0509	-1.90
46	154.0	0.0400	0.0428	-7.23
47	160.0	0.0300	0.0401	-33.74
48	180.0	0.0200	0.0323	-61.83

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	0.16			
T	-0.03	0.98		
B	0.00	0.00	0.00	
A	-0.36	0.01	0.00	0.83

S T B A



for: NAVY	PW–1 PT RECOVERY, MARCH 18 93
by: TRC Environmental Consultants, Inc.	NETC – TANK FARM FIVE NEWPORT, RI
Aquifer: BEDROCK – RHODE ISLAND FM Thickness: 30.4 Depth: 31.0 feet Screen: Base: 30.4 Top: 10.4 feet Distance: 20.5 feet Pumping well: PW–1	Date: MAR 18 93 | Well No.: MW–4

DATA SET: PT2MW4R

CLIENT:	NAVY	DATE:	MAR 18 93
LOCATION:	NETC - TANK FARM FIVE	WELL NO.:	MW-4
COUNTY:	NEWPORT, RI	FLOW RATE:	0.34 gal/min
PROJECT:	PW-1 PT RECOVERY, MARCH 18 93	WELL DEPTH:	31.00 feet
AQUIFER:	BEDROCK - RHODE ISLAND FM	THICKNESS:	30.40 feet
WATER TABLE:	18.60 feet	DURATION OF PUMPING:	1442.00 min
PUMPING WELL No:	PW-1	RADIUS FROM PUMPED WELL:	20.50 feet
	RADIUS OF WELL CASING:	1.000 in	

The following depths are from top of Aquifer:

PUMPING WELL:	SCREENED FROM	10.40 TO	30.40 feet
OBSERVATION WELL:	SCREENED FROM	0.00 TO	12.40 feet

FITTING ERROR: 3.971 PERCENT

Neuman, 1975: Par. Pen. Unconfined Aquifer

MODEL PARAMETERS:

STORAGE COEF:	1.739E-02	TRANSM:	516.283gal/feet/day
	FREE		FREE
ANISOTROPY [SQRT(Kz/Kr)]:			0.82674
			FREE
SPECIFIC YIELD:			3.309E+00
			FREE

No.	TIME (min)	DRAWDOWN (feet) DATA	SYNTHETIC	DIFFERENCE (percent)
1	0.0500	0.140	0.127	8.73
2	10.58	0.130	0.129	0.700
3	22.50	0.120	0.119	0.154
4	29.66	0.110	0.112	-2.31
5	37.33	0.100	0.104	-4.28
6	54.66	0.0900	0.0883	1.80
7	59.66	0.0800	0.0842	-5.25
8	85.50	0.0700	0.0655	6.30
9	101.5	0.0600	0.0566	5.64
10	117.0	0.0500	0.0494	1.14
11	135.0	0.0400	0.0424	-6.13
12	177.0	0.0300	0.0302	-0.934

PARAMETER RESOLUTION MATRIX:
"*" INDICATES FIXED PARAMETER

S	0.94			
T	0.04	0.66		
B	0.11	-0.12	0.20	
A	-0.06	0.29	0.15	0.73
	S	T	B	A

APPENDIX C

NEWPORT POTW DISCHARGE PERMIT APPLICATION

TRC
Environmental Solutions through Technology

TRC Environmental Corporation
5 Waterside Crossing
Windsor, CT 06095
☎ (203) 289-8631 Fax (203) 298-6399

April 22, 1993

Capt. W.H. Rigby
Environmental Protection Branch
Code 40E
Public Works Department
Naval Education and Training Center
1 Simon Petri Drive
Newport, RI 02841

RE: Newport POTW Industrial User Permit Application for
Interim Remedial Action - Groundwater Treatment at Tank Farm 5
TRC Project No. 12773-Q41-01

Dear Capt. Rigby:

Enclosed please find the completed Industrial User Permit Application and supporting information to discharge wastewater from Tank Farm 5 to the Newport POTW.

TRC has designed the proposed treatment system for contaminated groundwater at Tank Farm 5. Effluent from the proposed treatment system will flow by gravity to the existing sanitary sewer in the area of the Fire Fighting Training Center for eventual discharge to the Newport POTW.

The following is submitted in support of the permit application:

1.0 Purpose
2.0 Description
3.0 Flow Quantity and Duration
4.0 Treatment System Process Summary
5.0 Operation and Maintenance Plan
6.0 Spill Prevention and Control
7.0 Treated Water Effluent Monitoring
8.0 Point of Sewer Connection
9.0 Newport POTW Industrial User Permit Application

Please call me if you request further information.

Very truly yours,

TRC ENVIRONMENTAL CORPORATION

Ronald J. Nault

Ronald J. Nault, P.E.

RJN/wpc

NEWPORT POTW
INDUSTRIAL USER PERMIT APPLICATION PACKAGE
FOR
INTERIM REMEDIAL ACTION
GROUNDWATER TREATMENT AT TANK FARM 5
NETC, NEWPORT, RHODE ISLAND

CONTRACT NO. N62472-86-D-1282

APRIL 1993

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1.0 PURPOSE

The purpose of the proposed connection, which will ultimately result in treated groundwater being discharged to the Newport POTW, is to clean-up fuel oil-contaminated groundwater surrounding the underground storage tanks at Tank Farm 5. Tank Farm 5 is located at the Naval Education and Training Center (NETC) in Newport, Rhode Island (see Figure 1).

2.0 DESCRIPTION

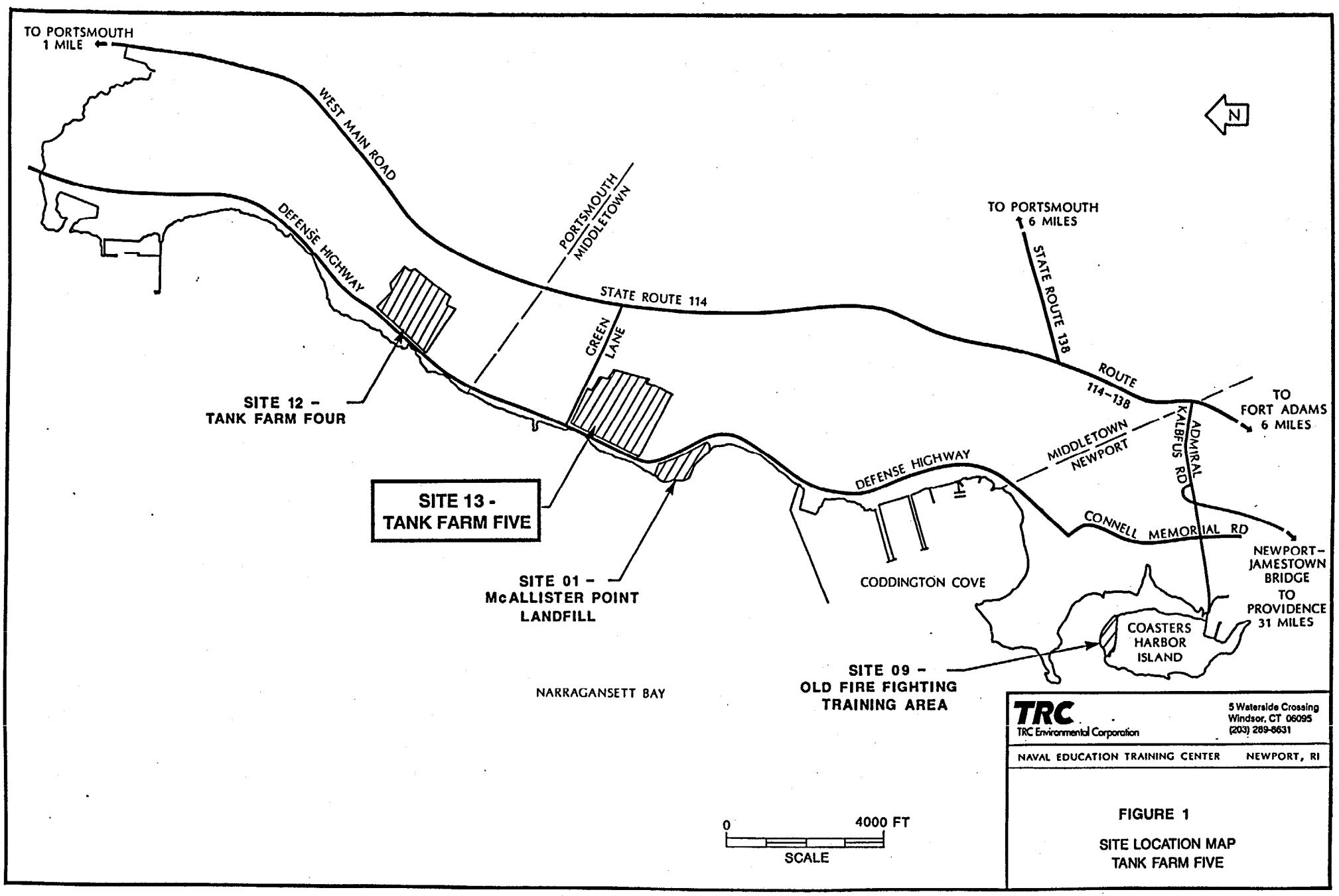
Groundwater in the area of Tank Farm 5 that contains contaminants exceeding the Safe Drinking Water Act maximum levels will be extracted and pumped to a central location for treatment. Inorganic and organic contaminant concentrations will be reduced in the treatment process to levels below the Newport POTW discharge limitations. The treated groundwater will flow by gravity to the existing sanitary sewer system installed for the Fire Fighting Training Facility (see Drawing C-2).

3.0 FLOW QUANTITY AND DURATION

The treatment system will be designed with a capacity of 50 gallons per minute (gpm) or 72,000 gallons per day (gpd). The groundwater extraction rate will be less than the treatment capacity and occur for an undetermined period of time until drinking water standards have been met.

4.0 TREATMENT SYSTEM PROCESS SUMMARY

Testing of the groundwater quality shows that inorganic compounds (metals) and volatile organic contaminants must be reduced as a pretreatment step prior to discharge to the Newport POTW. (See Appendix A for raw water quality data). A treatment system has been selected consisting of a flocculator/ clarifier and pressure media filter to precipitate and remove inorganics



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Windsor, CT 06095
(203) 289-8631

NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 1

SITE LOCATION MAP
TANK FARM FIVE

coupled with an ultraviolet light/oxidation chamber and granular activated carbon adsorption units to remove organics.

Figure 2 shows a process block flow diagram of the major treatment units and the various points of chemical adjustment, pumps and surge tanks required. Drawing M-1 shows the treatment equipment layout contained in a central building. The predicted water quality effluent from the treatment system is shown in Appendix A.

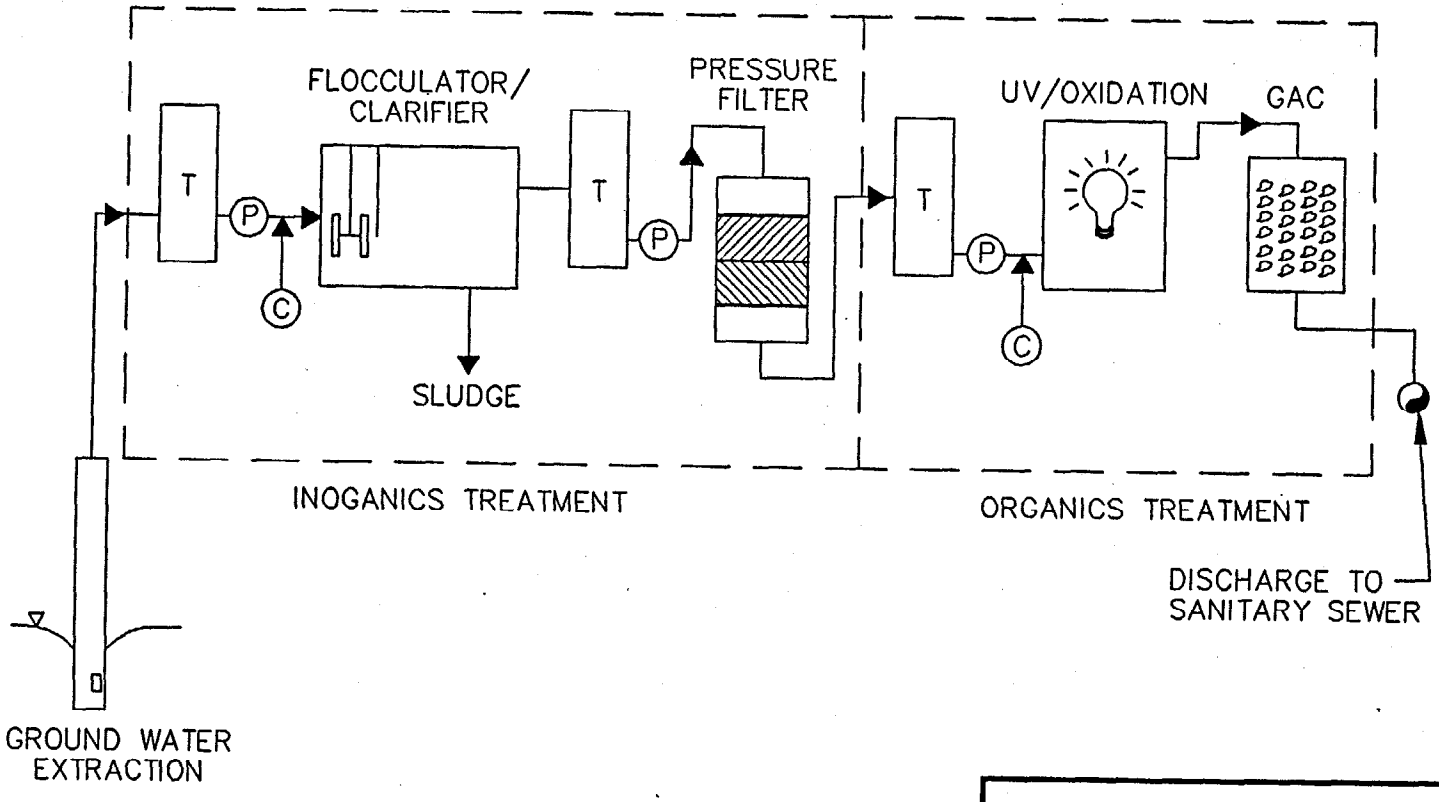
5.0 OPERATION AND MAINTENANCE PLAN

The treatment system will require an operator to monitor and adjust the equipment but will be equipped with complete sensors, instrumentation and controls for automated operation as well as emergency shut-down. All equipment will be provided with high level or failure sensors that will be interlocked to shut down the other processes and minimize system by-pass or accidental release. A detailed Operation and Maintenance Plan will be developed for the groundwater extraction and treatment system. The plan will include the following:

- Standard Operating Procedures
- Equipment Description and Maintenance
- Discharge Permit Requirements
- Monitoring and Reporting Procedures
- Emergency Operating Procedures
- Spill Response and Reporting
- Safety Procedures and Equipment

6.0 SPILL PREVENTION AND CONTROL

The treatment building will be constructed with a floor drain system to collect any spills of process water or treatment chemicals. The floor drains will be recycled to the influent of the treatment system. A detailed Spill Prevention and Control Plan will be developed for the treatment system.



KEY

T = SURGE TANK

(P) = PUMP

(C) = CHEMICAL FEED POINT

GAC = GRANULAR ACTIVATED CARBON

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SITE 13 - TANK FARM FIVE

FIGURE 2.

TREATMENT PROCESS
BLOCK FLOW DIAGRAM

Date: 3/93

Drawing No. 12773-Q41-01

7.0 TREATED WATER EFFLUENT MONITORING

It is proposed that the following constituents will be sampled and submitted to a RIDEM-certified laboratory for EPA-approved analysis:

Parameter	Frequency	Parameter	Frequency
Cadmium	Monthly	Sulfides	Monthly
Chromium (trivalent)	Monthly	Sulfates	Monthly
Chromium (hexavalent)	Monthly	Floating Oil	Monthly
Copper	Monthly	Fluoride	Monthly
Gold	Monthly	Mercuric Chloride	Monthly
Lead	Monthly	Phenols	Monthly
Nickel	Monthly	Total Toxic Organics	Monthly
Silver	Monthly	Suspended Solids	Monthly
Tin	Monthly	BOD	Monthly
Zinc	Monthly	pH	Monthly
Cyanides			

The proposed monitoring location is the sampling port at the end of the treatment system inside the new treatment building. The proposed Newport POTW discharge limitations are shown in Appendix A.

8.0 POINT OF SEWER CONNECTION

Treated water will flow by gravity in an 8" sanitary sewer to the existing sewer adjacent to the Fire Fighting Training Facility (see Drawing C-2). From this point of entry into the NETC sewer system, sewage will flow by gravity and in pumped force mains southerly along Defense Highway to eventual discharge to the Newport POTW.

9.0 NEWPORT POTW INDUSTRIAL USER PERMIT APPLICATION

The completed permit application is contained in Appendix B according to the Newport POTW guidelines.

APPENDIX A

RAW WATER QUALITY, PREDICTED TREATMENT PLANT EFFLUENT AND PROPOSED NEWPORT POTW DISCHARGE LIMITATIONS

APPENDIX A

The following table lists the predicted average raw water quality from the groundwater extraction wells, the predicted effluent water quality from the treatment system that will be discharged to the sanitary sewer and the proposed limitations for discharge to the Newport POTW.

TABLE 1

Contaminant	Average Predicted Groundwater Concentrations	Predicted Effluent from Treatment Plant	Proposed Newport POTW Discharge Limits
Inorganics (mg/l)			
Aluminum	26	<5.0	5.0
Arsenic	0.02	0.02	2.0
Barium	0.05	0.05	2.0
Beryllium	--	--	2.0
Cadmium	--	--	0.8
Chromium	0.06	0.06	3.0
Cobalt	0.10	0.10	2.0
Copper	0.05	0.05	1.0
Lead	0.04	0.04	0.1
Mercury	0.001	0.001	0.5
Nickel	0.07	0.07	3.0
Selenium	--	--	2.0
Silver	0.02	0.02	3.0
Vanadium	0.04	0.04	2.0
Zinc	0.24	0.24	1.2
Total Suspended Solids	400	30	285
BOD	2	2	230
pH	6.2	6	5.5-10.0

TABLE 1

(Continued)

Contaminant	Average Predicted Groundwater Concentrations	Predicted Effluent from Treatment Plant	Proposed Newport POTW Discharge Limits
Total Toxic Organics (µg/l)			
Vinyl Chloride	<1	<1	--
Methylene Chloride	18	<14	--
Acetone	15	<10	--
1,1-Dichloroethane	17	<10	--
1,2-Dichloroethene	60	<1	--
Chloroform	<1	<1	--
1,1,1-Trichloroethane	107	<75	--
Trichloroethene	75	<1	--
Tetrachloroethene	28	<1	--
Benzene	12	<1	--
Toluene	11	<1	--
Ethylbenzene	29	<2	--
Xylenes	147	<10	--
Naphthalene	16	<1	--
2-methylnaphthalene	58	<1	--
Total Toxic Organics	700	150	2,000
Other Organics			
Di-n-Butylphthalate	8	<1	--
Butylbenzylphthalate	2	<1	--
Bis(2-Ethylhexyl)Phthalate	53	<5	--

APPENDIX B

NEWPORT POTW INDUSTRIAL USER PERMIT APPLICATION

INDUSTRIAL USER PERMIT APPLICATION

GENERAL INFORMATION

_____Existing Discharge ___X___Proposed Discharge

1. Company name: Naval Education and Training Center

2. Mailing address: Public Works Department

Building 1

Newport, RI Zip Code 02841-5000

3. Premise address: Tank Farm 5

Adjacent to Defense Highway

NETC Zip Code 02841

4. Person to whom permit should be mailed:

Name: David Dorocz Title: Environmental Supervisor

5. Person to contact concerning the information provided herein:

Name: David Dorocz
Carl Stopper, P.E. Title: Environmental Supervisor
Project Manager

PRODUCT OR SERVICE INFORMATION

7. Indicate Principal Products manufactured and/or service activity at premises address. Indicate current production as percentage of plant capacity.

Abandoned Tank Farm - former storage of fuel and waste oils

8. Indicate applicable Standard Industrial (SIC) Code(s) for all processes (if known):

N/A Treatment of contaminated ground water

9. List Raw Materials. Include all liquids which are used or stored in bulk or in containers which have a capacity of greater than 5 gallons.

Raw Materials Treatment Chemicals	Quantity Used Per Year
Polyelectrolyte & Coagulant	300 gal (est.)
Sodium Hydroxide	6 00 gal (est.)
Hydrogen Peroxide	6,000 gal (est.)
Sulfuric Acid	600 gal (est.)

PLANT OPERATIONAL CHARACTERISTICS

10. Shift Information:

a. Average number of employees per shift:

1st 1 2nd -- 3rd --

b. Shift start times:

1st 7:00 a.m. 2nd -- 3rd --

c. Shifts normally worked each day:

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
1st	7:00 am 4:00 pm	7:00 am 4:00 pm	7:00 am 4:00 pm	7:00 am 4:00 pm	7:00 am 4:00 pm	7:00 am 4:00 pm	7:00 am 4:00 pm
2nd	-----	(Base security personnel only)				-----	-----
3rd	-----	(Base security personnel only)				-----	-----

11. Is production subject to seasonal variation?

a. If yes:

Month(s) of peak production: April, May, June

Process(es) involved: Ground water extraction and treatment

Maximum number of employees/shift:

1st 2 2nd ---------- 3rd ----------

No. days worked/week: 7

12. Does operation shut down for vacation, maintenance or other reasons?

Yes X No ----------

a. If yes, indicate period when shutdown occurs: Emergency failure of treatment system

13. Are major processes batch or continuous?

Description of Process	Continuous	Batch (Give frequency)
Ground water extraction system	X	----------
Treatment system	----------	Every 2,000 gallons 36 time per day (est.)
----------	----------	----------

WATER CONSUMPTION AND WASTEWATER INFORMATION

14. List raw water source (percent):

		Quantity (gal per day) Average	Maximum
a. Public Water Supply:	Yes	300	1200
b. Private Water Supply:			

15. Describe any raw water treatment processes utilized:

N/A

16. List water consumption in plant:

a. Cooling water _____ gallons per day

b. Boiler feed _____ gallons per day

c. Process water (Treated ground water) 72,000 gallons per day

d. Sanitary system 200 gallons per day

e. Contained in product _____ gallons per day

f. Other Wash down 100 gallons per day

g. Total 72,300 gallons per day

17. List average volume of discharge or water lost to:

a. City or Town sewer 72,300 gallons per day

b. Natural outlet _____ gallons per day

c. Waste hauler _____ gallons per day

d. Evaporation _____ gallons per day

e. Contained in product _____ gallons per day

f. Total 72,300 gallons per day

18. Describe any water recycling or material reclaiming process utilized:

N/A

19. Is discharge to sewer: Intermittent X Steady _____

20. List average water usage for each process shown in Item 8

Process	Average Water Consumption (gallons per day)
a. N/A	
b.	
c.	
d.	

21. Are there any proposed changes or expansion which would alter your present water usage or wastewater discharge?

Yes X No

a. If yes, please list and explain these changes: Expansion of treatment plant, if necessary

SEWER CONNECTION AND DISCHARGE INFORMATION

22. List and provide descriptive location of sewer connection or discharge points for plant sewer outlets, size and flow (attach and refer to map):

Sewer extension from existing system at Fire Fighting Training Facility

Sewer size (inches) 8

Average flow (gallons/day) 72,300

23. Is a Spill Prevention Control and Countermeasure Plan prepared for the facility

Yes No X

24. Describe what treatment is currently given to waste discharge (attach extra sheet if necessary): See attached

inorganic and organic contaminants pretreatment

25. State any known characteristics (i.e. pH, oil and grease, BOD and suspended solids, etc. of wastewater from each process listed in item 8 above (attach copy of wastewater analysis if available)

Process	Wastewater Characteristics
a. Ground water extraction	See Appendix A
b.	
c.	
d.	

26. Please indicate by placing an "X" in the appropriate box by each listed chemical whether it is "suspected to be present" or "known to be present" in your wastewater discharges.

CONFIDENTIALITY

All requests for confidentiality of information will be honored to the extent possible. To request that information provided to the City of Newport be kept confidential, please provide a signed request along with this application asking that such confidentiality be provided.

AUTHORIZED AGENT(S)

Name and Title Captain William H. Rigby, Director of Public Works

Address NETC, Newport, RI 02841-5000

Telephone Number (401) 841-3735

Name and Title _____

Address _____

Telephone Number _____

An authorized agent or authorized company representative is a person who is a principal executive officer or other corporate officer with signatory powers as per the company's by-law or per a vote of the directors if the company is a corporation; a general partner or proprietor if the company is a partnership or sole proprietorship respectively; or a duly authorized representative of individual designated above if such representative is responsible for the overall operation of the facility and has the authority to sign contracts, permits, permit applications, monitoring results and other documents in the company's name and otherwise bind the company. Please complete and submit appropriate certification form.

The City of Newport will not accept documents signed by persons other than the company's authorized agent(s) or authorized representative(s).

TABLE 1

PRIORITY POLLUTANTS

Please indicate the chemical compounds "suspected to be present" or "known to be present" in your industrial wastewater discharges.

ITEM NO.	CHEMICAL COMPOUND	KNOWN TO BE PRESENT	SUSPECTED TO BE PRESENT
1.	acenaphthene		
2.	acrolein		
3.	acrylonitrile		
4.	benzene	X	
5.	benzidine		
6.	carbon tetrachloride (tetrachloromethane)		
7.	chlorobenzene		
8.	1,2,4-trichlorobenzene		
9.	hexachlorobenzene		
10.	1,2-dichloroethane		
11.	1,1,1-trichloroethane	X	
12.	hexachloroethane		
13.	1,1-dichloroethane	X	
14.	1,1,2-trichloroethane		
15.	1,1,2,2-tetrachloroethane		
16.	chloroethane		
17.	bis(2-chloroethyl) ether		
18.	2-chloroethyl vinyl ether		
19.	2-chloronapthalene		
20.	2,4,6-trichlorophenol		
21.	4-chloro-3-methylphenol		
22.	chloroform (trichloromethane)	X	
23.	2-chlorophenol		
24.	1,2-dichlorobenzene		
25.	1,3-dichlorobenzene		
26.	1,4-dichlorobenzene		
27.	3,3-dichlorobenzidine		
28.	1,1-dichloroethylene		
29.	1,2-trans-dichloroethylene		
30.	2,4-dichlorophenol		
31.	1,2-dichloropropane		
32.	1,3-dichloropropene (cis and trans isomers)		
33.	2,4-dimethylphenol		
34.	2,4-dinitrotoluene		
35.	2,6-dinitrotoluene		
36.	1,2-diphenylhydrazine		

TABLE 1 (cont'd)

ITEM NO.	CHEMICAL COMPOUND	KNOWN TO BE PRESENT	SUSPECTED TO BE PRESENT
37.	ethylbenzene	X	
38.	fluoranthene		
39.	4-chlorophenyl phenyl ether		
40.	4-bromophenyl phenyl ether		
41.	bis(2-chloroisopropyl) ether		
42.	bis(2-chloroethoxy) methane		
43.	methylene chloride (dichloromethane)	X	
44.	methyl chloride (chloromethane)		
45.	methyl bromide (bromomethane)		
46.	bromoform (tribromomethane)		
47.	dichlorobromomethane		
48.	chlorodibromomethane		
49.	hexachlorobutadiene		
50.	hexachlorocyclopentadiene		
51.	isophorone		
52.	naphthalene	X	
53.	nitrobenzene		
54.	2-nitrophenol		
55.	4-nitrophenol		
56.	2,4-dinitrophenol		
57.	4,6-dinitro-2-methylphenol		
58.	N-nitrosodimethylamine		
59.	N-nitrosodiphenylamine		
60.	N-nitrosodi-n-propylamine		
61.	pentachlorophenol		
62.	phenol		
63.	bis-(2-ethylhexyl) phthalate	X	
64.	butyl benzyl phthalate	X	
65.	di-n-butyl phthalate	X	
66.	di-n-octyl phthalate		
67.	diethyl phthalate		
68.	dimethyl phthalate		
69.	benzo(a)anthracene (1,2-benzanthrancene)		
70.	benzo(a)pyrene (3,4-benzopyrene)		
71.	3,4-benzofluoranthene		
72.	benzo(k)fluoranthene(11,12-benzofluoranthene		
73.	chrysene		
74.	acenaphthylene		
75.	anthracene		
76.	benzo(ghi)perylene (1,12-benzoperylene)		
77.	fluorene		
78.	phenanthrene		

TABLE 1 (cont'd.)

ITEM NO.	CHEMICAL COMPOUND	KNOWN TO BE PRESENT	SUSPECTED TO BE PRESENT
79.	dibenzo(ah)anthracene (1,2,5,6-dibenzathracene)		
80.	indeno(1,2,3-cd)pyrene (2,3-o-phenylenepyrene)		
81.	pyrene		
82.	tetrachloroethylene	X	
83.	toluene	X	
84.	trichloroethylene	X	
85.	vinyl chloride (chloroethylene)	X	
86.	aldrin		
87.	dieldrin		
88.	chlordane (technical mixture and metabolites)		
89.	4,4' -DDT		
90.	4,4' -DDE (p,p' -DDE)		
91.	4,4' -DDD (p,p' -TDE)		
92.	a-endosulfan-Alpha		
93.	b-endossulfan-Beta		
94.	endosulfan sulfate		
95.	endrin		
96.	endrin aldehyde		
97.	heptachlor		
98.	heptachlor epoxide		
99.	a-BHC-Alpha		
100.	b-BHC-Beta		
101.	g-BHC (lindane) Gamma		
102.	d-BHC-Delta		
103.	PCB-1242 (Arochlor 1242)		
104.	PCB-1254 (Arochlor 1254)		
105.	PCB-1221 (Arochlor 1221)		
106.	PCB-1232 (Arochlor 1232)		
107.	PCB-1248 (Arochlor 1248)		
108.	PCB-1260 (Arochlor 1260)		
109.	PCB-1016 (Arochlor 1016)		
110.	toxaphene		
111.	antimony and compounds (total)		
112.	arsenic and compounds (total)	X	
113.	asbestos (fibrous)		
114.	beryllium and compounds (total)		
115.	cadmium and compounds (total)		
116.	chromium and compounds (total)	X	
117.	copper and compounds (total)	X	

TABLE 1 (cont'd.)

ITEM NO.	CHEMICAL COMPOUND	KNOWN TO BE PRESENT	SUSPECTED TO BE PRESENT
118.	cyanides (total)		
119.	lead and compounds (total)	X	
120.	mercury and compounds (total)	X	
121.	nickel and compounds (total)	X	
122.	selenium and compounds (total)		
123.	silver and compounds (total)	X	
124.	thallium and compounds (total)		
125.	zinc and compounds (total)	X	
126.	2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)		